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SAMUEL WILLIAM JOHNSON.

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# JAPANESE HOME LIFE.

By Dr. W. DELANO EASTLAKE.

IT must be confessed that the ideas of Japan and the Japanese which we are likely to gain through the current literature of the day are apt to be sadly confusing. This, I am quite confident, is not from any desire on the part of writers on Japanese subjects to encourage any false impressions, but rather from the very fact that neither poet nor artist traveler—ay, nor many of the long residents in Japan, for that matter—have opportunity to see or take part in the home life of the people of Japan.

But few visitors to that country have been able, in so short a time, to become so thoroughly *en rapport* with the customs and life of this interesting people as Sir Edwin Arnold, whose graceful writings show us how he has thought with them, lived with them, and loved with them in a deeper and truer sense than many of the oldest foreign residents, although his stay was comparatively short. Yet even in Sir Edwin's writings on Japan we see the poetry rather than the prose of Japanese life; and this is not to be wondered at, for of all countries and people none could appeal so deeply to the poet as does this fairyland of flowers and romance. The very air one breathes, the delicious sense of rest and quiet, the graceful courtesy of the people, the romantic beauty of mountain or highway, city or dwelling—all these, and far more, complete an ideal picture that awakens enthusiasm in the prosiest of tourists or visitors. It could surely scarcely have been otherwise that the author of the Light of Asia, whose very heart-strings are tuned to the melody of poetry, should have struck the keynote of Japanese life and awakened naught but answering chords of most enchanting harmony.

So he has given us these in his writings on Japan so vividly and artistically that we can almost hear the soft-voiced welcome of the serving maiden, as the *soji* is noiselessly pushed aside, and amid the subtle fragrance of the plum blossoms sink back among the silken cushions with that delicious sense of repose, while lulled to rest by the melodic echo of the *koto* strings, and find ourselves once more in fairyland Japan. And would it were only true!

Yet we are not all of us poets, and few of us are artists, and so find that there is prose beneath the fragrant blossoms that the poet's pen has so lavishly scattered over things Japanese. On the

THE SIESTA.

other hand, we find that the sweeping assertions regarding Japanese ethics and morals—or rather lack of morals—as contained in other writings on Japan, are both unjust and untrue.

On the one hand, Sir Edwin Arnold tells us that the women of Japan approach our ideal of the angelic, while another writer cries out against the utter lack of morality in Japanese women. Such diametrically opposed statements are distressingly confusing, and the characteristics of "angelic immorality" are hard to conceive of, and must be rather paradoxical, to say the least.

Should we desire to gain any true idea of the "prose and poetry" of Japan, we must look into the details of the home life of the people; for, after all, it is the daily routine, the domestic and social duties, the thoughts, pastimes, and aspirations typical

to any people that mold the ethics and character of the nation itself. In a word, we must enter the homes of both high and low, there to learn facts and not "foreign impressions."

But, alas! the task is one most difficult to accomplish, for it must be acknowledged that the vast majority of foreign residents, and practically all transient visitors to the country, see little or nothing of the details of the home life of the people. And why? Is the life of the people just what they see it to be in its picturesque and courteous superficiality, and is it indeed all poetry, music, and flowers, and no earnest reality?

Indeed, there is; for the word "home" has the same tender meaning in the hearts of the Japanese as with us; and the cricket that chirps so lustily on the hearths of American or English homes would find a rival songster in the cheery little fellow whose contented chirp by the side of the glowing brazier, or *hibachi,* makes such sweet music in Japanese homes.

Apart from the diplomatic and consular representatives from Western countries, the foreign residents of Japan are chiefly composed of merchants, missionaries, and a comparatively small number of professional men. The merchant or trading class represent by all odds the majority of the foreign community. Numerically, missionaries would come next. Indeed, it would not be an unfair estimate to state that these two classes constitute at least four fifths of the foreign population. Trading, as far as foreigners are concerned, is still limited to the treaty ports, including Yokohama, Kobé, Nagasaki, and a few others. Socially, the Japanese merchant ranks below the humblest tradesman, and, as all foreign trading with the interior must be carried on through the medium of these Japanese commission merchants, it is with this class of people that the majority of the foreign residents come in contact, and then only in their business relations, and seldom socially or intimately; although, were this the case, the idea gained of Japanese home life would be misleading, for the Japanese trader very soon learns to conform himself to the manners of his customers, and can not be regarded—as thus met—as typical of the truly Japanese.

The missionaries as well, for the most part at least, have little opportunity to study the details of the social or home life of the people they are working among. Theirs is a duty and vocation which from its very nature would render this well-nigh impossible. They are teachers, not students; they are bearers of spiritual truths, and must needs open warfare against the existing creeds of the people; and this attitude in itself would, in the majority of instances at least, debar them from entering into the pursuits or pastimes of the people. Before leaving the subject of missionaries, I would call attention to the frequent allusions made by the

Silk Merchant. Many of these shops open directly on the street. To the right is the cashier, fenced in by his latticed "office,"

representatives of certain missions, to the disrespect and disregard paid to them or their teachings by the Japanese. Such assertions are too sweeping, to say the least, as well as misleading, for many of the foreign missionaries in Japan have gained the high esteem of natives, and have endeared themselves, both by their noble, self-sacrificing lives, as well as ever ready sympathy and friendliness. There have been many missionaries sent to Japan during the past decade who are educationally sadly incompetent to meet the emergencies that present themselves in Japan. It must be borne in mind that the standard of education of the present generation in Japan is most high. The works of Huxley, Spencer, Darwin, and many others have, for the most part, been translated into Japanese, and the students and graduates of the university, the *Dai gakko,* are able to compete educationally with men from our best colleges and universities. The eagerness for knowledge that one finds so universally displayed among the Japanese, together with the remarkable advance in this direction that the nation has made during the past twenty years, and the prominent position Japan is assuming in its relations to America and European countries—all this commands our unbiased interest and respect.

The task of endeavoring to portray a clear, although of necessity incomplete, view of Japanese home life is one of no little difficulty. It would seem almost as difficult as an adequate description of a Beethoven sonata would be without the aid of music. For there is a subtle "something" about Japan in which, perhaps, the exquisite harmony of the land—the scenery and the people—plays an important part; yet a "something" that is wont to cast a charmed spell around one, and causes a former resident, like myself, to look back to the years spent in the "Land of the Rising Sun" as to the memory of some peaceful vision of fairyland. This indefinable charm can not be described in mere word-pictures, and yet escapes few visitors to Japan, and is seldom lost even after long residence in that country.

The sense of restfulness that pervades our Japanese towns, in bold contradistinction to that feeling of noisy hurry and feverish excitement of a busy American city, has been attributed to the comparative absence of horse traffic in the former. Undoubtedly this is a potent factor, but not the only one which gives that sense of quiet and repose already referred to. The courteous politeness of the people, both rich and poor, the general evidences of light-heartedness among even the poorest laboring classes, the absence of that distracting hurry and rush so typical of our great business centers, and in addition to all this the picturesque houses and streets, the spotlessly clean homes, the evidences everywhere of a national love for the beautiful and artistic, the absence of saloons

or barrooms, and their substitution by public bath-houses, at almost every corner—all these must be regarded as factors productive of this sense of quiet and rest. Then, again, the strange commingling of the new and the old—for, turning aside from some busy street thronged with shoppers, venders and tradesmen, a few steps may find us approaching some majestic temple gateway, leading to the shrine or tomb of some great hero of centuries gone by. Ascending the time-worn stone steps, and standing beneath the shadow of the lofty gabled roof of the gateway, our gaze may follow the intricate maze of lacquer and bronze architectural adornment until it is lost in the shadowy gloom overhead. On either side of the two central columns, and shut off by a railing, are the colossal figures of the "guardians of the temple," grim and gaunt, with sword in hand. Flanked on either side are the tall bronze or stone lanterns of the temple, and still beyond, back even of the font of water and the great temple bell in its gabled belfry, is the shrine itself, a fitting resting place or tribute to one who has served his country well, guarded as it is by gnarled and ancient pines and lofty cryptomarias that were ancient when the grandsires of the happy throng below ascended these self-same steps to offer a tribute to the memory of the hero.

There is a marked similarity in the daily routine of the inmates of Japanese homes, whether they be homes of the rich or poor, the official or tradesman. The wife is always the mistress of the home, and hers is the duty of in every way possible rendering the life of her husband happy—and to be happy herself, as far as he knows. The instruction of the daughters of the home in the various domestic duties also devolves upon the mother. The wardrobe of the entire family is the work of her hands, with the assistance, perhaps, of an aunt (*obāsan*), maid, or her growing daughters. The latter, by the way, are taught how to sew while yet quite little tots, and as they grow older in years and skill, are initiated into the mysteries of art needlework. Then the daughters are instructed in music, a certain knowledge of the *samisen*, *koto*, or some other musical instrument being regarded as a requisite accomplishment in even the poorer and middle classes, while the daughters of the higher classes and nobility are well versed in art, music, and the poetry of the country. The other accomplishments deemed desirable in women consist principally in the artistic arrangement of flowers and the details of ceremonial tea making and drinking (*cha-no-yu*).

The recitation, or reading of historical poems (*utai*) is a favorite study, especially if some romance is interwoven into the story. Usually the dramatic poems (*iōrori*) are ceremoniously read or sung by the young maidens, while an elder sister or teacher will thrum a minor accentuated accompaniment on the *samisen*. Some-

Gateway of an Ancient Buddhist Shrine.

times the story of the *utai* is told in prose to the eager group of children gathered around the glowing brazier, or *hibachi*. The latter, it must be confessed, in spite of its cheery appearance, radiates but a scant amount of heat in comparison with the open grates of the Occident. Such a family group may be seen in thousands of homes in Tōkyō alone, on a winter's afternoon; the boys, if back from school, resting contentedly on the white *tatami*, or studying the morrow's lessons in some quiet nook; the little maidens, demurely grouped about the *hibachi*, busily plying their needles, while listening to some story told by the old aunt or nurse, that may be acting as instructress. The contented hum of

Singing Girls playing on the Koto and Samisen.

the quaint old iron kettle, resting over the glowing coals, supported by an iron tripod thrust into the ashes of the *hibachi*, suggests its entire readiness to assist in the preparation of tiny cups of fragrant tea for any chance guest that arrives, or for any member of the family that wants a steaming cup of this delicate beverage—which is so much more dainty and delicious as prepared and drunk by the Japanese than by us.

It is then that the telling of stories finds its place in Japanese. The deeds of heroes, the romances of ancient dynasties, mystical lore, stories of ghosts and ghouls, and of the wicked and revengeful deeds of fox or badger sprites—this folk lore, historical or mythical, as it may be, has become so blended with the home life

of the people that one can not well dissociate the one from the other. The story of *Kogo-no-Tsuboné*—properly an *utai*, or historical poem—is a favorite on account of the sweet romance it contains.

THE STORY OF KOGO-NO-TSUBONÉ.

Long, long years ago, before the *Shoguns*, that now sleep in their ancient graves in Shiba, had gained power, and before the advent of foreigners had been even dreamed of, the peace-loving young Emperor Takakura, a monarch of the imperial line, graced the sacred throne of his ancestors.

But the imperial power of Takakura was but a nominal one, for the prime minister—one Kiyomori, of Taira descent—virtually ruled the land, and, to accomplish his ends more adroitly, had even caused his daughter to be made empress. Thus the peace-loving young monarch was a mere tool in the artful hands of Kiyomori. Indeed, his power was great, for the emperor could not have declared war or made peace against Kiyomori's tyrant will.

So, while the prime minister was scheming with his daughter the empress, the young monarch was forced to seek consolation in music and art, and found a willing and loving follower in one of his retainers, Nakakuni, who himself was a most skilled performer on the flute. Now, it happened that among the royal musicians at the palace there was a lady in waiting to the royal household who in music far outranked any other. Fair as a dream, gifted with the sweetest of voices, Kogo—for this was her name—was able to awaken music from her *koto* strings that seemed to spring from the very soul of the instrument. None but the tapering fingers of the fair Kogo could create such entrancing harmony, and it truly seemed as though the silken strings would murmur a loving response to her gentle caress.

Frequently the flutist Nakakuni would accompany Kogo's music and song, while the young emperor would listen like one entranced. These three passed many happy hours together; but as time wore on, the young monarch realized that sweet Kogo's music and verse had awakened love. But, alas! Kiyomori learned of the emperor's infatuation, and poor Kogo was compelled to secretly flee to the mountain forests of Saga in order to escape from the relentless persecutions of Kiyomori and his daughter the empress.

On learning of Kogo's flight from the palace, Takakura at once ordered his faithful retainer Nakakuni to go in search of the missing maiden, and look far and wide, and not to return until he had found her hiding place. The fleetest horse of the royal mews was made ready, and Nakakuni, bearing with him a message from the Emperor, was soon speeding toward the gloomy mountain of Saga.

Long he rode; the giant cryptomarias that flanked the highway towered overhead, and well-nigh shut out the remnant of the dying day. Night dropped her black pall over the earth as he entered the dark forests of the mountain, but far, far above the tree-tops the silver moon shone forth, with the stars peeping out

A Geisha, or Professional Entertainer and Musician.

one by one, as though desiring to aid the loyal retainer in his search. Again and again he would check his horse and stop to listen, for it seemed that he could hear the melodious tones of a *koto*. At last, when, far late into the night, he arrived at the ancient temple of Horin, the sounds became more audible, al-

though still distant. Was it the distant moan of some far-away tempest among the mountain peaks? Was it merely the night wind sighing through the lofty pines overhead? Or could it be the plaintive, liquid melody from the harp of the lost one? Checking his panting, foaming steed, Nakakuni listened intently, and while listening his heart began to beat wildly, for he now recognized the music of an old love song, and the magic touch of Kogo's fingers on the *koto* strings. Led by the guiding music, he soon reached a miserable-looking hut, whence the sounds proceeded. Dismounting at the door of the hut, he proclaimed himself a royal messenger and demanded admittance.

A voice from within answered that no dweller in so humble a hut was worthy of being the recipient of a message from the emperor, and that surely he had made some mistake. Not to be put off, however, Nakakuni declared that he had recognized Kogo's music, and that it was for Kogo that he was seeking. Then, indeed, he was made welcome to the humble abode; but, after delivering the emperor's message, the fair Kogo announced her determination to forsake the world forever and live the holy life of a recluse, and begged that Nakakuni would secure the emperor's pardon for her enforced disobedience to his commands. In vain did the faithful messenger endeavor to alter this determination, and presently the two fell to talking of the happy past at the palace. The *koto* was brought forth, and Kogo once more sang those well-known love songs, and the harp strings rang again with melody. The moments rolled into hours, and the day was breaking when Nakakuni took leave of the weeping and disconsolate maiden and rode slowly back to the palace alone.

. . . . . . . . .

Sometimes the story is ended here with the conclusion that Kogo became a Buddhist nun and spent her life in ministering to others, self-abnegation, and prayer; but the history of the romance, as set forth in the *utai*, is kindlier, for the emperor again sent for the sweet musician, who was finally prevailed upon to return to the palace, where she was restored to her former honorable position in the imperial household.

In rendering the above in English I have endeavored to retain, as far as possible, the quaintness of the original with which almost every Japanese is familiar. Regarding the purely legendary lore of Japan, this is as a rule most weird and mystical. The large variety of supernatural beings, for the most part of a purely psychical origin, is truly startling; indeed, it would be difficult to imagine or invent any grewsome form for an apparition that is not already an old inhabitant of Japanese "ghostdom."

But for "fireside" stories it is, after all, the recital of the uncanny and magical deeds of foxes and badgers that awakens the

In the Daidoku, or Kitchen, during the Preparation of the Morning Meal.

greatest interest among the children, and which are, for the most part, believed in even by the elders. In fact, among the more illiterate classes to be possessed with the spirit of a fox (*kitsuné-tsuki*) is a form of zoanthropy not infrequently met with, although the disorder is more likely to be assumed than real, and the epithet *kitsuné-tsuki*, or "fox-hearted," is more apt to be figuratively applied than otherwise. Undoubtedly the popular belief in the magical powers of foxes and badgers in Japan is as extensive as the frequently unexpressed belief in the supernatural found in this country. The educated classes will decry any such superstitious belief, and yet will tell you of alleged experiences of their friends or relatives with foxes or badgers, which are "very strange and not to be accounted for." Fox and badger stories are therefore highly appreciated by the juvenile members of any Japanese family, principally on account of their "authenticity," and because of that fascinating condition of fear and "the creeps" that their recital occasions. Here is a good badger story, the truth of which I can vouch for, insomuch as there is a field of Inami near Kyōtō, and that it is a grewsome spot well suited for a trysting place for ghouls and ghosts.

### THE BURIAL AT MIDNIGHT.*

Not far from Kyōtō, in the smiling hill-land of Harima, there is a broad, open plain known as the "Field of Inami." Although surrounded by verdant hillsides, this plain is bleak and barren: great gusts of wind sweep over the long, dry grasses, and no farmer or peasant has ever found a home in this desolate spot. Yet the great highway to Kyōtō runs just to one side of the plain, and on this road a postman used to carry his load of letters once or twice every week. A little bypath leads across one corner of the plain, lessening the distance to the city, and this path was a great favorite with the postman, as it made his journey so much the shorter.

Going one day as usual to Kyōtō, he reached the field a little later than was his wont, and night came on before he had advanced very far. Without a light or the means of procuring one, he wandered aimlessly on for a while, but finally seeing that he had missed the path in the darkness, resolved to pass the night where he was, with the sky for a coverlet. Without giving a second thought to all the ugly stories told of the field, the ghosts and malicious fox-sprites said to hold their nightly revels in that spot, the postman bravely determined to make the best of it, and

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* This tale was first translated from the Japanese into German, and read, among others, before the Gesellschaft für Völkerkunde in Ost-Asien, in Yokohama, by F. Warrington Eastlake, Ph. D.

was just looking for some sort of shelter when he caught sight of a little, half-ruined hut. Drawing nearer, he found that it was a sort of watch-house, such as the peasants build near the rice-fields in order to protect the growing grain. Overjoyed at having found even this poor shelter, the postman entered the little hut, and, throwing himself on a heap of dried grass, was soon fast asleep. Perfect silence reigned over the sterile plain; only now and again the far-off hoot of an owl or the mournful cry of some night bird broke the stillness of the night.

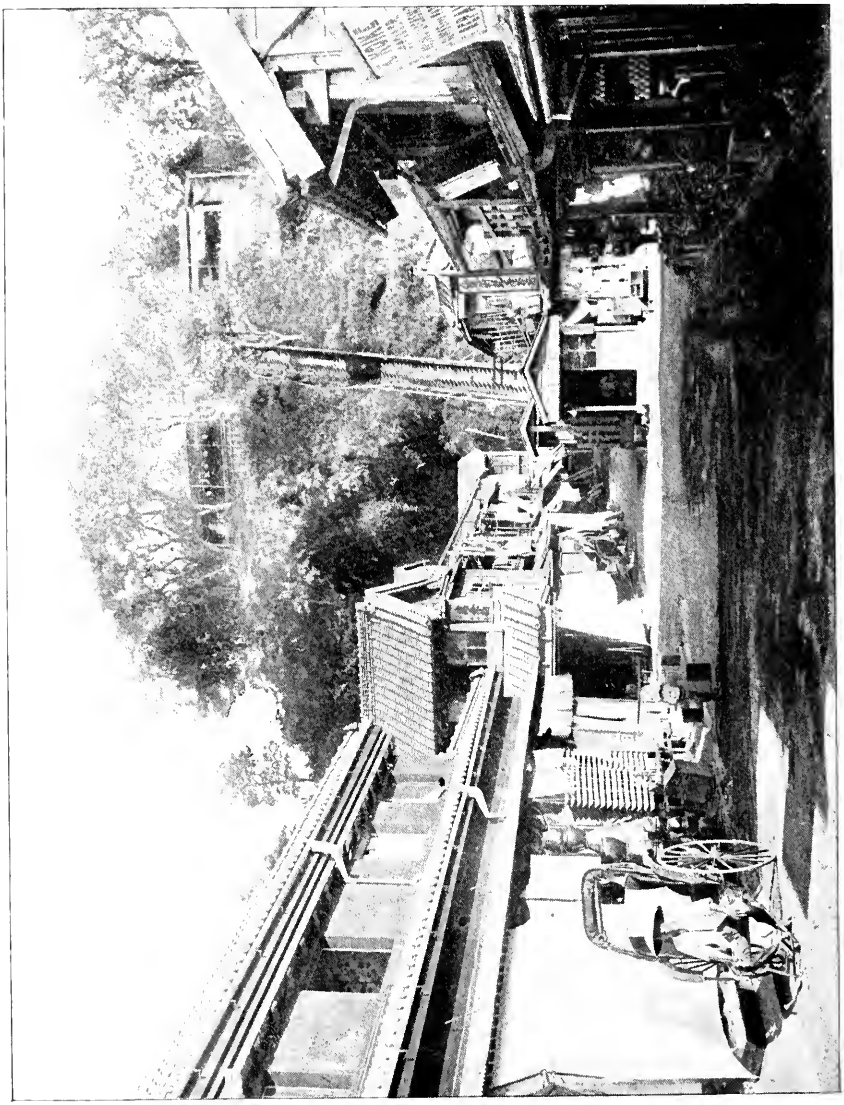
Several hours had passed, when the sleeper was suddenly awakened by the deep, sonorous note of a bell. The sound seemed to come from the western portion of the field, and all at once the startled sleeper heard a tramping as of many feet, and a confused murmur of Buddhist chants and prayers. Nearer and nearer came the crowd of people, to the listener's great astonishment. "There are no houses in the field," thought he, "and anyhow no one would think of going at midnight to such a deserted and ill-omened spot." The stars were shining brightly, but no moon illumined the scene, so that the trembling postman could only see objects very near him. Nevertheless he peeped cautiously out of his hiding place and saw, to his unbounded surprise, a long procession of men bearing torches and lanterns. In front of all marched a tall priest, reciting the Buddhist invocation, *Namu Amida Butsu*, in a clear, loud voice. "It is a funeral procession!" thought the frightened listener, and crept farther back into the shadows of the hut.

As soon as the mournful procession had reached the little hut a halt was made, and the coffin-bearers stepped forward. Scarcely five paces from the hut the grave was dug, and the coffin placed in it. The priest then threw the earth back into the grave and built a little mound above it, and finally placed a few sticks covered with Buddhist characters in one end of the mound. Without further word the somber procession turned back, and moved slowly away in the same solemn and impressive manner, leaving the postman in a most pitiable frame of mind. It was quite bad enough to be compelled to spend the night in such an uncanny and grewsome spot; but the late hour, mysterious burial, and the proximity of the freshly dug grave were enough to frighten the bravest heart.

As if chained to the spot by some evil spell, the postman kept staring at the little mound before him. Suddenly, while he was gazing fixedly at the grave, it began to rock slowly from side to side. Quicker and quicker became the rocking, while the involuntary spectator underwent an agony of terror. Faster and faster still rocked the mound, until it fell over with a great shock, and a naked, horrid thing jumped from the grave and ran toward the

Meal Time. Each member of the family has a lacquered table to himself, while the maid waits in readiness to replenish the bowls with rice served from the covered bucket.

postman. In an instant he remembered that horrible ghouls always attend a burial, and that these ghouls often kill and eat living beings. There was no time to lose, for the creature had already reached the entrance of the hut. Crazed with fear, the



THE "ONE HUNDRED STEPS" LEADING TO THE BLUFF AND TEA HOUSE, YOKOHAMA.

postman drew his sword and made one desperate cut at his enemy, and then, without daring to give a second blow, ran out of the hut and into the night.

Hours seemed to have passed before the postman arrived, half dead with exhaustion and panting for breath, at the house of a

peasant, just beyond the outskirts of the field. He knocked again and again, but no one came in answer, and so he had to wait for the day to dawn. Shortly after sunrise the people of the house arose, and, hearing the knocking, took the still breathless wanderer into the guest chamber, where they attended to his pitiable state, and then begged him to relate what had befallen him. This he did, and the peasants at once determined to go to the little hut in the field of Inami, which was well known to them. Upon arriving at the spot they found no signs of a burial or of a grave. Mound and coffin had utterly disappeared; but just in front of the hut lay the body of a huge badger, killed by the one cut of the good steel. At once they saw what had happened. The evil beast had wished to frighten the belated wanderer; and the funeral procession and priest, coffin, and grave had been merely the work of magic.

So much for the stories that play such an important *rôle* in the drama of home life in Japan. It is to be regretted that this subject has not been more extensively dealt with in recent writings of the country, for many of the hidden beauties of the country and people are best portrayed in the stories of bygone heroes, as told to the children around the *hibachi,* or as sung by some graceful maiden with *samisen* or *koto* accompaniment; while the tales of ghosts or ghouls rival those of almost any other land in variety and horror.

Turning to the pastimes common to Japanese homes, a brief mention of the most popular games must not be omitted. *Go* and *shogi* are similar to our games of draughts and chess, yet the former is far more scientific than checkers. There are several games of cards, the playing cards being about as long as those used in this country, but scarcely three quarters of an inch wide. Another favorite game is that of "One Hundred Poems." It is somewhat similar to our rather childish game of "Authors," with the exception that the Japanese game is by no means childish, and requires an intimate knowledge of at least one hundred poems of well-known merit. Two hundred cards are used in the game, and half a poem is written on each card. The cards being spread before the players, the half of a poem on any one card is read, and the other half searched for by the contestants. Then the different seasons of the year have typical games. The most picturesque of these is *haguita,* or "battledoor and shuttlecock," which is exclusively a New-Year's game. Then the time of the cherry blooms brings its games beneath the bloom-laden branches. Music and song find their way into the homes of Japan far more extensively than in this country. To be sure, the music of either *koto* or *samisen* is apt to sound strange, and at first perhaps almost unin-

telligible, to our untutored ears; but we soon become familiar with the plaintive notes of the *koto* or the sonorous vibrations of the *samisen*, and learn to both recognize and appreciate the quaint minor harmonies and softly worded melody of some love song, or *so-fu-ren*.

As I have already had occasion to mention, the dramatic or operatic poems are sung with the accompaniment of the *samisen*, while the historical poems, or *utai*, find a musical accompaniment only when recited on the *nō* stage, and then flute and drums are the instruments used. The dramatization of the *utai* upon the *nō* stages is a very ancient custom, and can only be appreciated by the better educated classes. Correctly speaking, *nō* is a his-

Facsimile of a Poem by Aritsuné.

torical dance, full of weird mysticisms almost unintelligible to those not conversant with its meaning, but its proper performance is a classic art. It has remained unchanged in the slightest detail for centuries, and through its medium the classic historical poetry of the nation is retained and placed before the appreciative public of the higher class.

Thus the drama and history of the country, so full of heroism and romance, shape themselves into poetry and song. The blending of art with poetry is another feature typical of the Japanese people. There are two purely Japanese schools of art: the one dealing with the minutest details, and the other with the bold and forcible portrayal of impressions and suggestions, rather than details; graceful sketches, rather than detailed drawings. "We

can not reproduce Nature in art," a Japanese artist has said, "and instead of making so bold an attempt, had best satisfy ourselves with mere suggestions of Nature's beauties." The same may be said of some Japanese poetry, for the *uta*, or sonnets, usually are mere poetic suggestions of a deeper meaning or sentiment. This brings one to a realization of the close connection between art and poetry in Japan, as also between poetry and music. In social gatherings among friends, a favorite mode for mutual entertainment is for one of the guests to quickly sketch some passing thought or memory of one of Nature's beauties; it may be the crest of some distant mountain, a branch heavy with blossoms, or a flower. This sketch is then passed on to another guest, who, in looking at it, seeks to find some poetic suggestion, or hidden lesson, and having done so, adds the verse to the sketch, and the picture is complete. These illustrated sonnets, the fruits of poetic inspiration and artistic impression, are taken home, to be preserved as cherished souvenirs of the evening's entertainment.

To illustrate this more clearly, we will say that an artist has, with two or three rough strokes of his brush, depicted a bleak mountain peak, with a flock of birds flying above it. This is passed to Aritsuné, a Japanese poet of recognized merit, who after a few moments' thought adds a sonnet to the sketch. It is, like the sketch, a mere suggestion of a deeper sentiment, or *imi*, as the Japanese would have it. I can best render it as follows, making the translation as literal as possible:

We may struggle to the peak
Of the mountain, bare and bleak,
There but to learn,
And well discern,
That the winging birds above,
Speeding to their nests of love,
More of Nature's beauties see
Far than we.

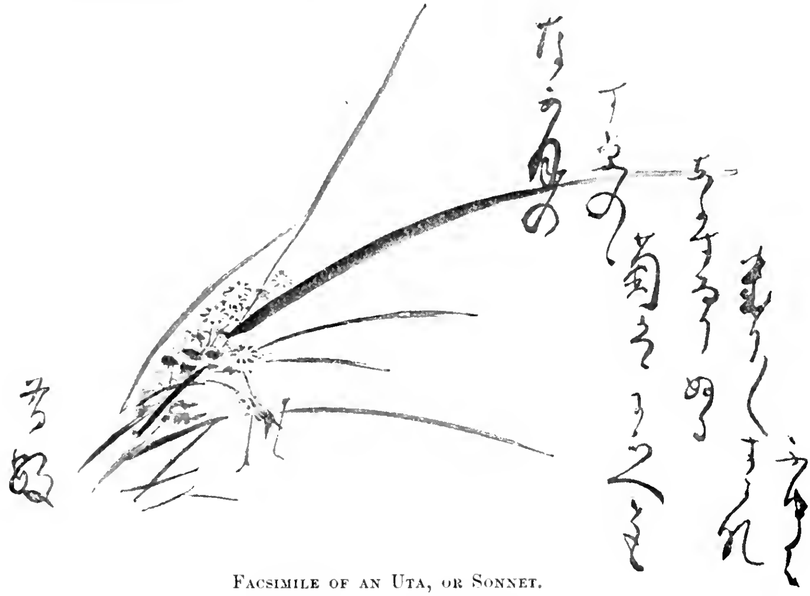
Surely the beauty of the thought is evident, and the deeper meaning, or *imi*, appreciable even to the prosiest of us. Yet in rendering the lesson of the sonnet, as implied to the Japanese reader of the above words, I might add the following lines:

So, when striving naught but fame to obtain,
Thou chance mayst reach the highest peak of earthly gain;
Then thou wilt learn,
And well discern,
That Nature doth her beauties wide outspread
For those to daily duties who are wed.
While simple lives yield peace and light,
Fame blinds the sight.

One more example of this variety of illustrated verse will suffice, and in the one I have chosen the meaning is confessedly obscure, or at least deep enough to require some thought. The picture, or sketch, is one of a bunch of wild flowers (chrysanthemums), which make their first appearance during the closing days of September, by which time, also, the cheery voice of the locust has been hushed by the increasing cold of the autumn:

Though September's last days are fast ebbing away,
 And the locust's bright sonnet is stilled,
Yet the wild flowers fair breathe a far sweeter song
 While the air with their fragrance is filled.

In justice it must be confessed that the *imi* of the above lines is rather vague, but may be regarded as a reminder of Nature's kind compensation, for, with the change of seasons, one beauty is



Facsimile of an Uta, or Sonnet.

scarcely missed before another has filled its place. Perhaps the words may be construed as a gentle reproof to discontented spirits. That the very heart of the nation finds its voice in song is quite evident, for in every instance where a sonnet or poem would find application we are sure to find one. During the time of the cherry and plum blossoms, in early spring, the bloom-laden branches are further ornamented by numerous sonnets inspired by the beauty of the scene—written on strips of white paper, and then made fast to the low-hanging branches. Indeed, the poetic enthusiasm of a score of Orlandos in the forests of Arden would be put to shame. Every season of the year, with the flowers that

it brings, is praised in verse. From the chrysanthemums in autumn, the camellias and plum blossoms of the winter months, the cherry and peach blossoms and wistaria during early spring, the peony in May, and the great lotus flowers during the summer months, so every season has its typical flower, and every flower is loved and praised in song and sonnet by the people. There is room for flowers in the humblest abode, and even the crests of the thatch-roofed huts of the farmers are transformed into miniature gardens of hyacinths and tulips.

So we have pushed aside the latticed doors and glanced in at the Japanese home. True, our stay has been short, and much must be left unnoticed; yet, as we take our reluctant leave, above the soft melody of the *koto* strings, we can clearly hear the lusty chirp of the "cricket on the hearth."

## THE INADEQUACY OF "NATURAL SELECTION."

By HERBERT SPENCER.

ALONG with that inadequacy of natural section to explain changes of structure which do not aid life in important ways, alleged in § 166 of The Principles of Biology, a further inadequacy was alleged. It was contended that the relative powers of co-operative parts can not be adjusted solely by survival of the fittest; and especially where the parts are numerous and the co-operation complex. In illustration it was pointed out that immensely developed horns, such as those of the extinct Irish elk, weighing over a hundredweight, could not, with the massive skull bearing them, be carried at the extremity of the outstretched neck without many and great modifications of adjacent bones and muscles of the neck and thorax; and that without strengthening of the fore-legs, too, there would be failure alike in fighting and in locomotion. And it was argued that while we can not assume spontaneous increase of all these parts proportionate to the additional strains, we can not suppose them to increase by variation one at once, without supposing the creature to be disadvantaged by the weight and nutrition of parts that were for the time useless—parts, moreover, which would revert to their original sizes before the other needful variations occurred.

When, in reply to me, it was contended that co-operative parts vary together, I named facts conflicting with this assertion—the fact that the blind crabs of the Kentucky caves have lost their eyes but not the foot-stalks carrying them; the fact that the normal proportion between tongue and beak in certain selected varieties of pigeons is lost; the fact that lack of concomitance in de-

crease of jaws and teeth in sundry kinds of pet dogs, has caused great crowding of the teeth (The Factors of Organic Evolution, pp. 12, 13). And I then argued that if co-operative parts, small in number and so closely associated as these are, do not vary together, it is unwarrantable to allege that co-operative parts which are very numerous and remote from one another vary together. After making this rejoinder I enforced my argument by a further example—that of the giraffe. Tacitly recognizing the truth that the unusual structure of this creature must have been, in its more conspicuous traits, the result of survival of the fittest (since it is absurd to suppose that efforts to reach a high branch could lengthen the legs), I illustrated afresh the obstacles to co-adaptation. Not dwelling on the objection that increase of any components of the fore-quarters out of adjustment to the others would cause evil rather than good, I went on to argue that the co-adaptation of parts required to make the giraffe's structure useful, is much greater than at first appears. This animal has a grotesque gallop, necessitated by the great difference in length between the fore and the hind limbs. I pointed out that the mode of action of the hind limbs shows that the bones and muscles have all been changed in their proportions and adjustments; and I contended that, difficult as it is to believe that all parts of the fore-quarters have been co-adapted by the appropriate variations now of this part, now of that, it becomes impossible to believe that all the parts in the hind-quarters have been simultaneously co-adapted to one another and to all the parts of the fore-quarters: adding that want of co-adaptation, even in a single muscle, would cause fatal results when high speed had to be maintained while escaping from an enemy.

Since this argument, repeated with this fresh illustration, was published in 1886, I have met with nothing to be called a reply; and might, I think, if convictions usually followed proofs, leave the matter as it stands. It is true that, in his Darwinism, Mr. Wallace has adverted to my renewed objection and, as already said, contended that changes such as those instanced can be effected by natural selection, since such changes can be effected by artificial selection: a contention which, as I have pointed out, assumes a parallelism that does not exist. But now, instead of pursuing the argument further along the same line, let me take a somewhat different line.

If there occurs some change in an organ, say, by increase of its size, which adapts it better to the creature's needs, it is admitted that when, as commonly happens, the use of the organ demands the co-operation of other organs, the change in it will generally be of no service unless the co-operative organs are changed. If, for instance, there takes place such a modification

of a rodent's tail as that which, by successive increases, produces the trowel-shaped tail of the beaver, no advantage will be derived unless there also take place certain modifications in the bulks and shapes of the adjacent vertebræ and their attached muscles, as well, probably, as in the hind limbs, enabling them to withstand the reactions of the blows given by the tail. And the question is, by what process these many parts, changed in different degrees, are co-adapted to the new requirements—whether variation and natural selection alone can effect the readjustment. There are three conceivable ways in which the parts may simultaneously change: (1) they may all increase or decrease together in like degrees; (2) they may all simultaneously increase or decrease independently, so as not to maintain their previous proportions or assume any other special proportions; (3) they may vary in such ways and degrees as to make them jointly serviceable for the new end. Let us consider closely these several conceivabilities.

And first of all, what are we to understand by co-operative parts? In a general sense, all the organs of the body are co-operative parts, and are respectively liable to be more or less changed by change in any one. In a narrower sense, more directly relevant to the argument, we may, if we choose to multiply difficulties, take the entire framework of bones and muscles as formed of co-operative parts; for these are so related that any considerable change in the actions of some entails change in the actions of most others. It needs only to observe how, when putting out an effort, there goes, along with a deep breath, an expansion of the chest and a bracing up of the abdomen, to see that various muscles beyond those directly concerned are strained along with them. Or, when suffering from lumbago, an effort to lift a chair will cause an acute consciousness that not the arms only are brought into action, but also the muscles of the back. These cases show how the motor organs are so tied together that altered actions of some implicate others quite remote from them.

But without using the advantage which this interpretation of the words would give, let us take as co-operative organs those which are obviously such—the organs of locomotion. What, then, shall we say of the fore and hind limbs of terrestrial mammals, which co-operate closely and perpetually? Do they vary together? If so, how have there been produced such contrasted structures as that of the kangaroo, with its large hind limbs and small fore limbs, and that of the giraffe, in which the hind limbs are small and the fore limbs large—how does it happen that, descending from the same primitive mammal, these creatures have diverged in the proportions of their limbs in opposite directions? Take, again, the articulate animals. Compare one of the lower types, with its rows of almost equal-sized limbs, and one of the higher

types, as a crab or a lobster, with limbs some very small and some very large. How came this contrast to arise in the course of evolution, if there was the equality of variation supposed?

But now let us narrow the meaning of the phrase still further; giving it a more favorable interpretation. Instead of considering separate limbs as co-operative, let us consider the component parts of the same limb as co-operative, and ask what would result from varying together. It would in that case happen that, though the fore and hind limbs of a mammal might become different in their sizes, they would not become different in their structures. If so, how have there arisen the unlikeness between the hind legs of the kangaroo and those of the elephant? Or if this comparison is objected to, because the creatures belong to the widely different divisions of implacental and placental mammals, take the cases of the rabbit and the elephant, both belonging to the last division. On the hypothesis of evolution these are both derived from the same original form, but the proportions of the parts have become so widely unlike that the corresponding joints are scarcely recognized as such by the unobservant: at what seem corresponding places the legs bend in opposite ways. Equally marked, or more marked, is the parallel fact among the *Articulata*. Take that limb of the lobster which bears the claw and compare it with the corresponding limb in an inferior articulate animal, or the corresponding limb of its near ally, the crayfish, and it becomes obvious that the component segments of the limb have come to bear to one another in the one case proportions immensely different from those they bear in the other case. Undeniably, then, on contemplating the general facts of organic structure, we see that the concomitant variations in the parts of limbs have not been of a kind to produce equal amounts of change in them, but quite the opposite—have been everywhere producing inequalities. Moreover, we are reminded that this production of inequalities among co-operative parts, is an essential principle of development. Had it not been so, there could not have been that progress from homogeneity of structure to heterogeneity of structure which constitutes evolution.

We pass now to the second supposition:—that the variations in co-operative parts occur irregularly, or in such independent ways that they bear no definite relations to one another—miscellaneously, let us say. This is the supposition which best corresponds with the facts. Glances at the faces around yield conspicuous proofs. Many of the muscles of the face and some of the bones, are distinctly co-operative; and these respectively vary in such ways as to produce in each person a different combination. What we see in the face we have reason to believe holds in the limbs as in all other parts. Indeed, it needs but to compare people whose arms are of the same lengths, and observe how stumpy are

the fingers of one and how slender those of another; or it needs but to note the unlikeness of gait of passers-by, implying small unlikenesses of structure; to be convinced that the relations among the variations of co-operative parts are anything but fixed. And now, confining our attention to limbs, let us consider what must happen if, by variations taking place miscellaneously, limbs have to be partially changed from fitness for one function to fitness for another function—have to be re-adapted. That the reader may fully comprehend the argument, he must here have patience while a good many anatomical details are set down.

Let us suppose a species of quadruped of which the members have for long past periods been accustomed to locomotion over a relatively even surface, as, for instance, the "prairie dogs" of North America; and let us suppose that increase of numbers has driven part of them into a region full of obstacles to easy locomotion—covered, say, by the decaying stems of fallen trees, such as one sees in portions of primeval forest. Ability to leap must become a useful trait; and, according to the hypothesis we are considering, this ability will be produced by the selection of favorable variations. What are the variations required? A leap is effected chiefly by the bending of the hind limbs so as to make sharp angles at the joints, and then suddenly straightening them; as any one may see on watching a cat leap on to the table. The first required change, then, is increase of the large extensor muscles, by which the hind limbs are straightened. Their increases must be duly proportioned, for if those which straighten one joint become much stronger than those which straighten the other joint, the result must be collapse of the other joint when the muscles are contracted together. But let us make a large admission, and suppose these muscles to vary together; what further muscular change is next required? In a plantigrade mammal the metatarsal bones chiefly bear the reaction of the leap, though the toes may have a share. In a digitigrade mammal, however, the toes form almost exclusively the fulcrum, and if they are to bear the reaction of a higher leap, the flexor muscles which depress and bend them must be proportionately enlarged; if not, the leap will fail from want of a firm *point d'appui*. Tendons as well as muscles must be modified; and, among others, the many tendons which go to the digits and their phalanges. Stronger muscles and tendons imply greater strains on the joints; and unless these are strengthened, one or other dislocation will be caused by a more powerful spring. Not only the articulations themselves must be so modified as to bear greater stress, but also the numerous ligaments which hold the parts of each in place. Nor can the bodies of the bones remain unstrengthened; for if they have no more than the strengths needed for previous move-

ments they will fail to bear more violent movements. Thus, saying nothing of the required changes in the pelvis as well as in the nerves and blood-vessels, there are, counting bones, muscles, tendons, ligaments, at least fifty different parts in each hind leg which have to be enlarged. Moreover, they have to be enlarged in unlike degrees. The muscles and tendons of the outer toes, for example, need not be added to so much as those of the median toes. Now, throughout their successive stages of growth, all these parts have to be kept fairly well balanced; as any one may infer on remembering sundry of the accidents he has known. Among my own friends I could name one who, when playing lawn-tennis, snapped the Achilles tendon; another who, while swinging his children, tore some of the muscular fibers in the calf of his leg; another who, in getting over a fence, tore a ligament of one knee. Such facts, joined with every one's experience of sprains, show that during the extreme exertions to which limbs are now and then subject, there is a giving way of parts not quite up to the required level of strength. How, then, is this balance to be maintained? Suppose the extensor muscles have all varied appropriately; their variations are useless unless the other co-operative parts have also varied appropriately. Worse than this. Saying nothing of the disadvantage caused by extra weight and cost of nutrition, they will be causes of mischief—causes of derangement to the rest by contracting with undue force. And then, how long will it take for the rest to be brought into adjustment? As Mr. Darwin says concerning domestic animals: "Any particular variation would generally be lost by crossing, reversions etc., . . . unless carefully preserved by man." In a state of nature, then, favorable variations of these muscles would disappear again long before one or a few of the co-operative parts could be appropriately varied, much more before all of them could.

With this insurmountable difficulty goes a difficulty still more insurmountable—if the expression may be allowed. It is not a question of increased sizes of parts only, but of altered shapes of parts, too. A glance at the skeletons of mammals shows how unlike are the forms of the corresponding bones of their limbs; and shows that they have been severally remolded in each species to the different requirements entailed by its different habits. The change from the structures of hind limbs fitted only for walking and trotting to hind limbs fitted also for leaping, implies, therefore, that along with strengthenings of bones there must go alterations in their forms. Now the spontaneous alterations of form which may take place in any bone are countless. How long, then, will it be before there takes place that particular alteration which will make the bone fitter for its new action? And what is the

probability that the many required changes of shape, as well as of size, in bones will each of them be effected before all the others are lost again? If the probabilities against success are incalculable, when we take account only of changes in the size of parts, what shall we say of their incalculableness when differences of form also are taken into account?

"Surely this piling up of difficulties has gone far enough"; the reader will be inclined to say. By no means. There is a difficulty immeasurably transcending those named. We have thus far omitted the second half of the leap, and the provisions to be made for it. After ascent of the animal's body comes descent; and the greater the force with which it is projected up, the greater is the force with which it comes down. Hence, if the supposed creature has undergone such changes in the hind limbs as will enable them to propel it to a greater height, without having undergone any changes in the fore limbs, the result will be that on its descent the fore limbs will give way, and it will come down on its nose. The fore limbs, then, have to be changed simultaneously with the hind. How changed? Contrast the markedly bent hind limbs of a cat with its almost straight fore limbs, or contrast the silence of the upward spring on to the table with the thud which the fore paws make as it jumps off the table. See how unlike the actions of the hind and fore limbs are, and how unlike their structures. In what way, then, is the required co-adaptation to be effected? Even were it a question of relative sizes only, there would be no answer; for facts already given show that we may not assume simultaneous increases of size to take place in the hind and fore limbs; and, indeed, a glance at the various human races, which differ considerably in the ratios of their legs to their arms, shows us this. But it is not simply a question of sizes. To bear the increased shock of descent the fore limbs must be changed throughout in their structures. Like those in the hind limb, the changes must be of many parts in many proportions; and they must be both in sizes and in shapes. More than this. The scapular arch and its attached muscles must also be strengthened and remolded. See, then, the total requirements. We must suppose that by natural selection of miscellaneous variations, the parts of the hind limbs shall be co-adapted to one another, in sizes, shapes, and ratios; that those of the fore limbs shall undergo co-adaptations similar in their complexity, but dissimilar in their kinds; and that the two sets of co-adaptations shall be effected *pari passu*. If, as may be held, the probabilities are millions to one against the first set of changes being achieved, then it may be held that the probabilities are billions to one against the second being simultaneously achieved, in progressive adjustment to the first.

There remains only to notice the third conceivable mode of adjustment. It may be imagined that though, by the natural selection of miscellaneous variations, these adjustments can not be effected, they may nevertheless be made to take place appropriately. How made? To suppose them so made is to suppose that the prescribed end is somewhere recognized; and that the changes are step by step simultaneously proportioned for achieving it—is to suppose a designed production of these changes. In such case, then, we have to fall back in part upon the primitive hypothesis; and if we do this in part, we may as well do it wholly—may as well avowedly return to the doctrine of special creation.

What, then, is the only defensible interpretation? If such modifications of structure produced by modifications of function as we see take place in each individual, are in any measure transmissible to descendants, then all these co-adaptations, from the simplest up to the most complex, are accounted for. In some cases this inheritance of acquired characters suffices by itself to explain the facts; and in other cases it suffices when taken in combination with the selection of favorable variations. An example of the first class is furnished by the change just considered; and an example of the second class is furnished by the case before named of development in a deer's horns. If, by some extra massiveness spontaneously arising, or by formation of an additional "point," an advantage is gained either for attack or defense, then, if the increased muscularity and strengthened structure of the neck and thorax, which wielding of these somewhat heavier horns produces, are in a greater or less degree inherited, and in several successive generations, are by this process brought up to the required extra strength, it becomes possible and advantageous for a further increase of the horns to take place, and a further increase in the apparatus for wielding them, and so on continuously. By such processes only, in which each part gains strength in proportion to function, can co-operative parts be kept in adjustment, and be readjusted to meet new requirements. Close contemplation of the facts impresses me more strongly than ever with the two alternatives—either there has been inheritance of acquired characters, or there has been no evolution.—*Contemporary Review.*

[*To be concluded.*]

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In his work on Burma and Farther India, General A. R. MacMahon, ex-Political Resident, expresses the opinion that the caste restriction on social intercourse, the absence of which in Burma gives occasion for much pleasant intimacy with Europeans, has preserved the natives of India from many evils—the result of a too sudden introduction to European ways and habits to which the Burmese succumb.

# EVIDENCES OF GLACIAL MAN IN OHIO.

By Prof. G. FREDERICK WRIGHT.

THE recent sweeping denials by Mr. W. H. Holmes, of the Bureau of Ethnology, respecting the validity of the evidence upon which the existence of glacial man in America has been so generally accepted makes it necessary to present the facts in greater detail than has heretofore been done. It seems that Mr. Holmes has been himself looking for palæolithic implements in undisturbed gravel of glacial age for two or three years, but has not found any; and that he has discovered that the Indians had quarries and workshops in various places where they threw aside great piles of partially wrought and rejected implements which were of such shape as not to be readily available for their purposes, and which had a faint resemblance to palæolithic implements. In view of these experiences Mr. Holmes has come to the conclusion, first, that all the so-called palæolithic implements which have been found by Dr. C. C. Abbott and others in America are simply "rejects"; and, secondly, that nobody in America has found any implements in undisturbed gravel of glacial age. In Science for January 20, 1892, he uses the following language: "If there was, as is claimed, an ice-age man, or at any rate a palæolithic man, in eastern America, the evidence so far collected in support of these propositions is so unsatisfactory and in such a state of utter chaos that the investigation must practically begin anew."

The best answer which I can give to this sweeping denial will be to present, with illustrations, the details concerning a single discovery in Ohio with which I am familiar, namely, that at Newcomerstown. But, to get the full significance of this discovery, and the cumulative value of the evidence afforded by it, a brief statement of other discoveries must be made.

The evidence naturally begins with that at Trenton, N. J., where Dr. C. C. Abbott has been so long at work. Dr. Abbott, it is true, is not a professional geologist, but his familiarity with the gravel at Trenton, where he resides, the exceptional opportunities afforded to him for investigation, and the frequent visits of geologists have made him an expert whose opinion is of the highest value upon the question of the undisturbed character of the gravel deposit. The gravel banks which he has examined so long and so carefully have been extensively exposed by the undermining of floods on the river-side, but principally by the excavations which have been made by the railroad and by private parties in search of gravel. For years the railroads had been at work digging away the side of the banks until they had removed

a great many acres of the gravel to a depth of twenty or twenty-five feet. Any one can see that in such conditions there has been no chance for "creep" or landslides to have disturbed the stratification: for the whole area was full of gravel, and there was no chance of disturbance by natural causes. Now, Dr. Abbott's testimony is that up to the year 1888 sixty of the four hundred palæolithic implements which he had found at Trenton had been found at recorded depths in the gravel. Coming down to specifications, he describes in his reports the discovery of one (see Primitive Industry, page 492) found while watching the progress of an ex-

Fig. 1.—Section of the Trenton Gravel, in which the Implements described in the Text are found. The shelf on which the man stands is made in process of excavation. The gravel is the same above and below. (Photograph by Abbott.)

tensive excavation in Centre Street, which was nearly seven feet below the surface, surrounded by a mass of large cobble-stones and bowlders, one of the latter overlying it. Another was found at the bluff at Trenton, in a narrow gorge where the material forming the sides of the chasm had not been displaced, under a large bowlder nine feet below the surface (ibid., page 496). Another was found in a perpendicular exposure of the bluff immediately after the detachment of a large mass of material, and in a surface that had but the day before been exposed, and had not

yet begun to crumble. The specimen was twenty-one feet from the surface of the ground.

In all these and numerous other cases Dr. Abbott's attention was specially directed to the question of the undisturbed character of the gravel, he having been cautioned upon this point in the early part of his investigations.

Here it is proper to premise that the apparent monopoly of this evidence by Prof. Putnam and his associates in the Peabody Museum at Cambridge, Mass., has come about by a legitimate and natural process, which at the same time has probably interfered to a considerable extent with the general spread of the specific information in hand. Early in the investigations at Trenton, Prof. Putnam, who had lately become curator of the museum, with its large fund for prosecuting investigations, satisfied himself of the genuineness of Dr. Abbott's discoveries, and at once retained him as an assistant in the work of the museum, thus diverting to Cambridge all his discoveries at Trenton. Living on the ground during long-continued and extensive excavations made by the railroad, Dr. Abbott's opportunities were exceptionally favorable; hence his own prominence in the whole matter.

It is important also to note that, before taking up with Dr. Abbott's work, Prof. Putnam took ample pains to satisfy himself


FIG. 2.—SECTION ACROSS THE DELAWARE RIVER AT TRENTON, N. J.: *a, a.* Philadelphia red gravel and brick clay (McGee's Columbia deposit); *b, b.* Trenton gravel, in which the implements are found; *c.* present flood plain of the Delaware River (after Lewis). (From Abbott's Primitive Industry.)

of its character and correctness. In 1878 Prof. J. D. Whitney visited Trenton in company with Mr. Carr, assistant curator of the museum. In the Twelfth Annual Report Mr. Carr writes: "We were fortunate enough to find several of these implements in place. Prof. Whitney has no doubt as to the antiquity of the drift, and we are both in full accord with Dr. Abbott as to the artificial character of many of these implements." In reporting further upon this instance at the meeting of the Boston Society of Natural History, on January 19, 1881, Mr. Carr states that the circumstances were such that "it [i. e., one of the particular implements] must have been deposited at the time the containing bed was laid down." In 1879, and again in 1880, Prof. Putnam spent some time at Trenton, and succeeded in finding with his own hands "five unquestionable palæolithic implements from the gravel, at various depths and at different points." One of these was four feet below the surface soil and one foot in from the perpendicular face which had just been exposed, and where it was

clear that the gravel had not been disturbed. A second one was eight feet below the surface. (Proc. Boston Soc. of Nat. Hist. for January 19, 1881.)

As confirming the entire trustworthiness of Dr. Abbott's observations, it is to be noted that, with a single exception, all the implements reported below the loam which constitutes the surface soil are of argillite, while those upon the surface, which are innumerable, are chiefly of a different type, made from flint and jasper, or of other material of related character. Another fact, which has always had great weight in my own mind, is one mentioned by the late Prof. Carvill Lewis, in his chapter upon the subject at the end of Dr. Abbott's volume on Primitive Industry. I have the more reason to feel the force of his conclusions, because the proof-sheets passed through Lewis's hands at the time we were together conducting the survey in Pennsylvania, soon after we had visited the deposits in question. The fact was this: Prof. Lewis had been at work for a considerable time in classifying and mapping the gravels in the Delaware Valley, being all the while in ignorance of Dr. Abbott's work until his own results were definitely formulated. But, after he had accurately determined the boundary between the glacial gravels and the far older gravels which surround them and spread over a considerable portion of the territory beyond, he found that the localities where Mr. Carr, Prof. Putnam, and Dr. Abbott had reported finding their implements in undisturbed gravel, all fell within the limits of the glacial gravels, and had in no case been put outside of those limits. Now, Dr. Abbott's house is situated upon the older gravel; but at the time of most of his discoveries he had not learned to distinguish the one gravel from the other. If these implements are all from the surface and had been commingled with lower strata by excavations, landslides, or windfalls, there is no reason why they should not have been found in the older gravels as well as in those of glacial age. There is here a coincidence which is strongly confirmatory of the correctness of our conclusion that there is no mistake in believing that the implements were originally deposited with the gravel where they were found.

Such was the progress of discovery at the time when I began my special investigations upon the glacial boundary in Ohio, and of the glacial terraces there corresponding in age with that at Trenton. To the similarity of conditions along these streams I promptly called attention in 1883, pointing out various places in Ohio where it would be profitable for local observers to be upon the lookout for such evidences of glacial man as had been discovered by Dr. Abbott. The first response to this came from Dr. C. L. Metz, of Madisonville, on the Little Miami River, in southern

Ohio. Dr. Metz is a physician of large practice, of high character, and of long experience as an assistant of Prof. Putnam in exploring the mounds of Ohio. He knows the difference between disturbed and undisturbed gravel as perfectly as any one does. His residence is upon the glacial terrace which borders the Little Miami Valley. In 1885, while digging a cistern in this terrace, a perfectly formed implement of black chert was found by him in undisturbed gravel eight feet below the surface. This was exhibited by Prof. Putnam at a meeting of the Boston Society of Natural History, on the 4th of November, 1885, and is No. 40,970 in the Peabody Museum. Two other implements were discovered at a later time by Dr. Metz in the talus of the glacial terrace of the Little Miami, at Loveland, where also numerous bones of the

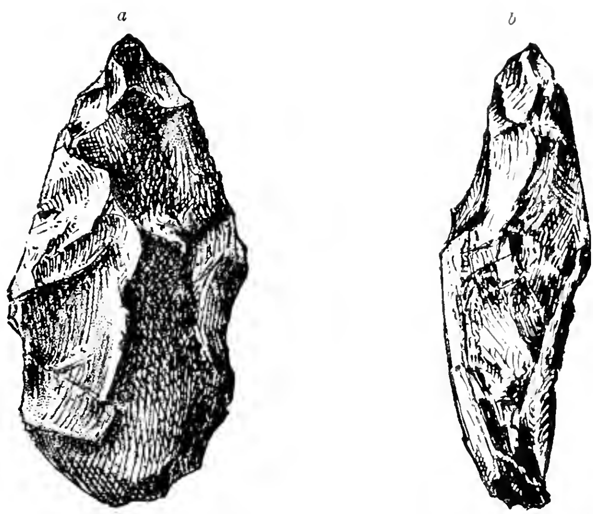


FIG. 3.—CHIPPED PEBBLE OF BLACK CHERT, found by Dr. C. L. Metz, October, 1885, at Madisonville, Ohio, in gravel eight feet from surface under clay: *a*, face view; *b*, side view. Natural size.

mammoth were found. But, as these were not in place when discovered, they can not be adduced as positive evidence.

The discovery at Newcomerstown, of which Messrs. Holmes, Brinton, and McGee speak so lightly because they do not know the facts, is really one of the best attested of all the single cases. The discovery was made in 1889 by Mr. W. C. Mills. The implement has been presented to the Western Reserve Historical Society of Cleveland, and can there be seen at any time in company with various implements from France. A photogravure from it appears in the smaller figure in the following cut.

The discovery of the implement was made in October, but it was not brought to public notice until the next spring, when I chanced to meet Mr. Mills and learned about it. He then for-

warded it to me, when its exact resemblance in form and finishing to an implement which I have in my own collection, that was obtained by Dr. Evans, of London, at Amiens, France, greatly impressed me. I forwarded it immediately to Prof. H. W. Haynes,

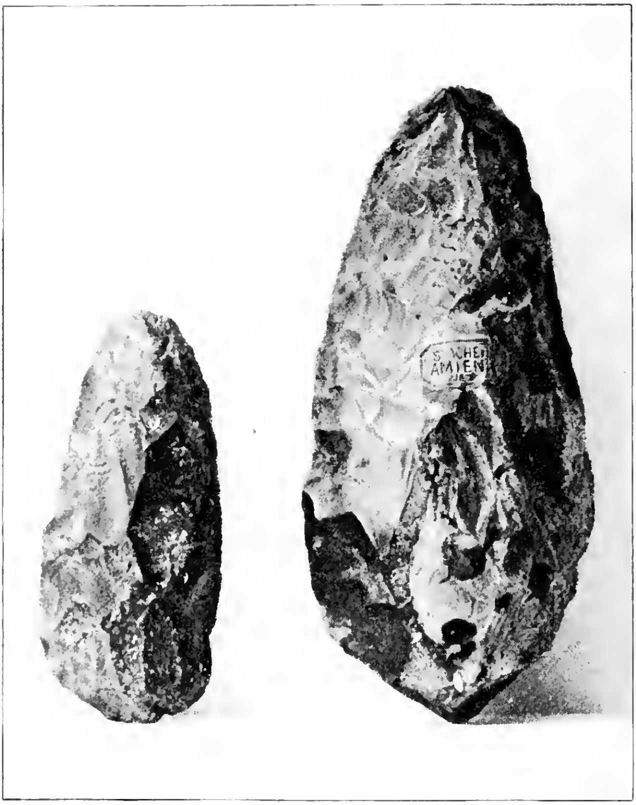

FIG. 4.—THE SMALLER IS THE PALÆOLITH FROM NEWCOMERSTOWN, THE LARGER FROM AMIENS, FRANCE (face view). Reduced one half in diameter.

of Boston, whose expert judgment is second to that of no other person in America, or indeed of the world. Prof. Haynes exhibited it at the meeting of the Boston Society of Natural History on May 7, 1890, and his account was published in the Proceedings of that evening. In conclusion, after having enumerated its distinctive characteristics, he said, "I desire to express most emphatically my belief in the genuineness and age of this Newcomerstown implement, as well as to call attention to the close resemblance in all particulars which it bears to these unquestioned paleolithic implements [which he exhibited beside it] of the Old World." This implement is not a "reject," but is a finished implement, with the secondary chippings all around the edge. The

cuts, reproduced from photographs, perfect as they are, by no means do it justice.

I promptly gave an account of this discovery in The Nation, in its issue for April 24, 1890, and repeated it in substance with some additional particulars on page 620 of the third edition of my volume on The Ice Age in North America. This account was also reprinted in The Popular Science Monthly, Volume XXXIX, pages 314 to 319. The account in my later volume, on Man and the Glacial Period, is still more condensed. The more detailed evidence is published in Tract No. 75 of the Western Reserve Historical Society, Cleveland, Ohio, containing the report of the meet-

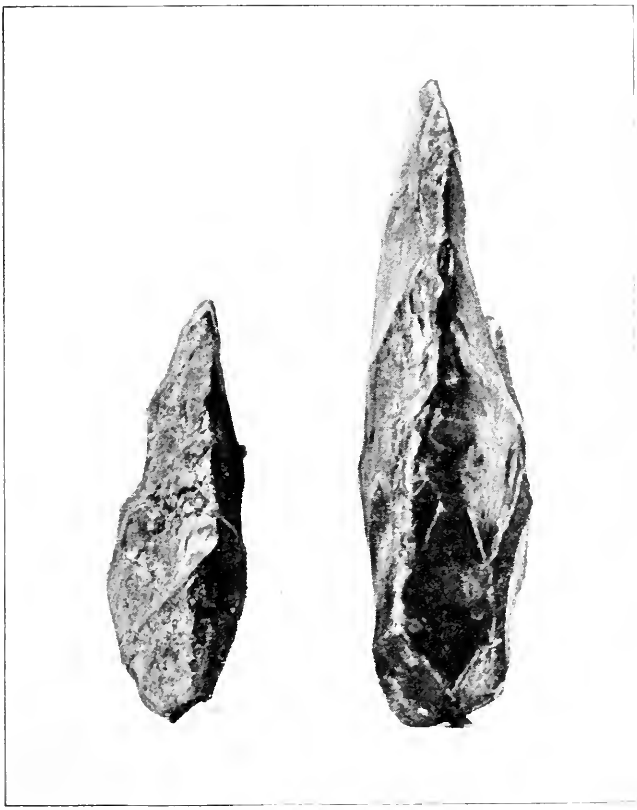

FIG. 5.—EDGE VIEW OF THE PRECEDING.

ing when Mr. Mills was present and gave his own testimony. This was held December 12, 1890.

The facts are these: There is a glacial gravel terrace in Newcomerstown at the mouth of Buckhorn Creek, where it enters the larger valley of the Tuscarawas River. There can be no question about the glacial age of this terrace. It is continuous up the

river to the terminal moraine. Its surface is about thirty-five feet above the flood-plain of the Tuscarawas; it consists of stratified material, containing many granitic pebbles and much granitic gravel. The deposit at Newcomerstown extends over many acres, having been protected from erosion in the recess at the

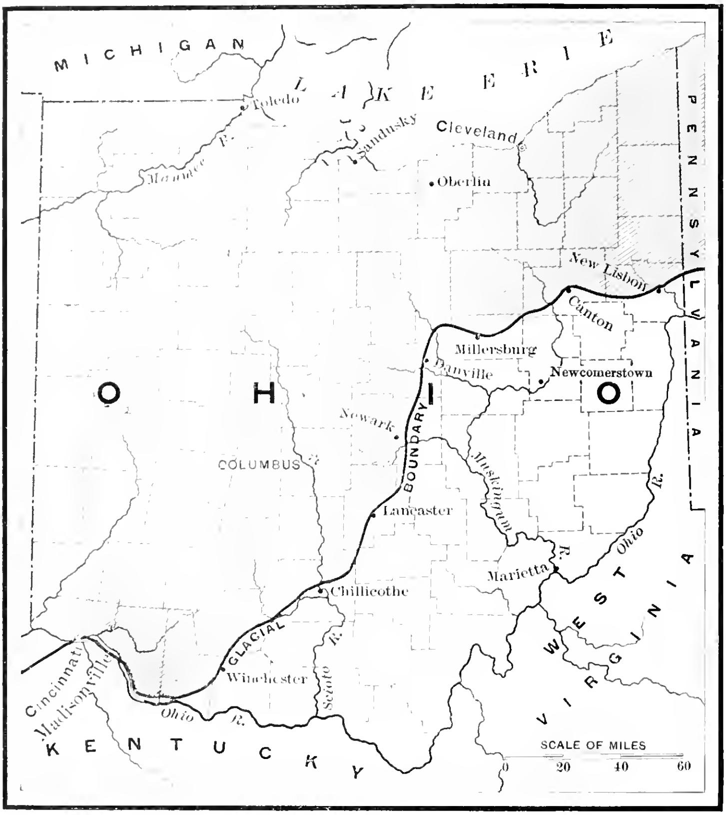


Fig. 6.

mouth of Buckhorn Creek. Through the middle of this deposit the railroad had cut its road-bed, and for years has been appropriating the gravel for ballast.

Mr. Mills is an educated business man, who had been a pupil in geology of Prof. Orton, of the State University, and had with him done considerable field-work in geology. Mr. Mills's character and reputation are entirely above suspicion. In addition to his business he took a laudable interest in the collection of Indian relics, and had in his office thousands of flint implements, collected by him and his associates in the vicinity, who had been organized into an archæological society. His office was but a short distance from the gravel pit from which I have said the

railroad had been for so many years obtaining ballast. The perpendicular face of this bank of gravel as it was exposed from time to time by the excavations of the railroad men was frequently examined by Mr. Mills, not with special reference to finding implements, for that thought had not entered his mind, but for the sake of obtaining specimens of coral, which occasionally occurred in the gravel. While engaged in one of these rounds, on the 27th of October, 1889, he found this specimen projecting from a fresh exposure of the perpendicular bank, fifteen feet below the surface, and, according to his custom, recorded the facts at the time in his note-book. There was no lack of discrimination in his observations, or of distinctness in his memory.

The accompanying illustration from a photograph taken six months after the discovery, and when a talus consequent upon the frosts of winter had accumulated to a considerable extent at

FIG. 7.—TERRACE IN NEWCOMERSTOWN, SHOWING WHERE W. C. MILLS FOUND A PALÆOLITHIC IMPLEMENT.

the base of the deposit, shows the spot in the bank from which the implement was taken. In looking for objects of his quest, Mr. Mills thrust in his cane into the coarser gravel which is seen to overlie the finer deposits. This resulted in detaching a large mass about six feet long and two feet wide, which fell down at his

feet. It was in the face of the bank behind this mass that Mr. Mills's eye, so long trained for the detection of artificially chipped flints, discovered the implement under consideration, which he removed with his own hands, and placed in his collection, with little thought at the time of the significance attaching to the position in which it was found. The accompanying map of the vicinity and drawing of the bank were made by Mr. Mills at the time of our visit, and furnish, with the photograph, all the additional information necessary.

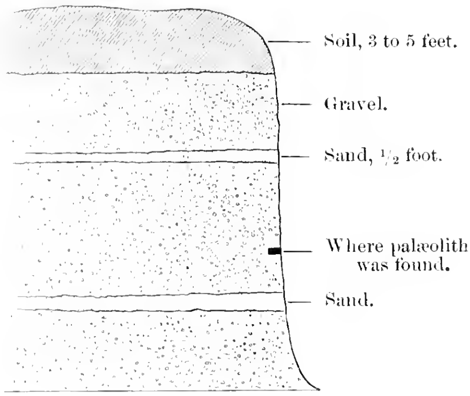


FIG. 8.

There is no possibility of mistake concerning the undisturbed character of the gravel from which Mr. Mills took the implement. All the strata were clearly exposed and observed by him.

These facts, submitted at the meeting of the Western Reserve Historical Society referred to, were fully detailed upon the spot

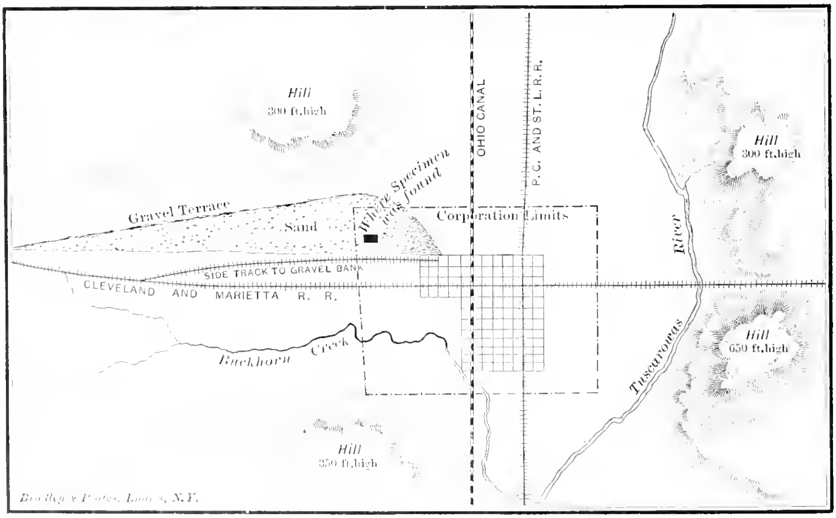


FIG. 9.—Height of Terrace exposed, 25 feet. Palæolith was found $14\frac{3}{4}$ feet from surface.

to myself and a party of gentlemen, consisting of Judge C. C. Baldwin, E. A. Angell, Esq., William Cushing, Esq., all lawyers of eminence, and Mr. David Baldwin, who accompanied me in a

visit to the place on the 11th of April, 1890. We had all the opportunity to question and cross-question that could be desired.

In conclusion, it is proper to say that the sweeping character and the suddenness of these attacks of Mr. Holmes and his associates upon the evidence of glacial man in America have been somewhat bewildering. It has come like thunder from a clear sky. One has but to go back to Mr. McGee's article in The Popular Science Monthly for November, 1888, to find an unquestioning and enthusiastic indorsement of nearly all the facts concerning glacial man which I have incorporated in my recent volume upon Man and the Glacial Period, together with a number which I have omitted, except the discovery at Newcomerstown, which had not then been made. Had I been aware of the preparations which these investigators were making to discredit all past observers on the matter, I should have introduced more detailed evidence in my summary in the volume referred to. Still, it is probably as well that the statements were left as they are, for they are all capable of ample proof; and it is perhaps better for the public to be referred for details to such fuller reports as are made in this article and in the other publications here indicated.

I submit that this evidence is neither "chaotic" nor "unsatisfactory," but is as specific and definite and as worthy to be believed as almost anything any expert in this country, or any other country, can be expected to produce.

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# GROWTH OF OUR KNOWLEDGE OF THE DEEP SEA.

By G. W. LITTLEHALES,

CHIEF OF THE DIVISION OF CHART CONSTRUCTION, UNITED STATES HYDROGRAPHIC OFFICE.

BEFORE the time of the project for the Atlantic telegraph cable in 1854, there seemed to be no practical value attached to a knowledge of the depths of the sea, and, beyond a few doubtful results obtained for purely scientific purposes, nothing was clearly known of bathymetry, or of the geology of the sea bottom. The advent of submarine cables gave rise to the necessity for an accurate knowledge of the bed of the ocean where they were laid, and lent a stimulus to all forms of deep-sea investigation. But although our extensive and accurate knowledge of the deep sea is of so late an origin, the beginnings of deep-sea research date far back into antiquity. The ancients can not be said to have had any definite conceptions of the deep sea. Experienced mariners, like the Phœnicians and Carthaginians, must necessarily have possessed some knowledge of the depths of the waters with which they were familiar, but this knowledge, whatever its extent, has

now passed away. To the writings of Aristotle, who lived during the fourth century B. C., are credited the first bathymetric data. He states that the Black Sea has whirlpools so deep that the lead has never reached the bottom; that the Black Sea is deeper than the Sea of Azov, that the Ægean is deeper than the Black Sea, and that the Tyrrhenian and Sardinian Seas are deeper than all the others. The first record of a deep-sea sounding should be credited to Posidonius, who stated, about a century B. C., that the sea about Sardinia had been sounded to a depth of one thousand fathoms. No account is given of the manner in which the sounding was taken, and we have no information as to the methods employed by the ancients in these bathymetric measurements.

The opinions of the learned with respect to the greatest depth of the sea, in the first and second centuries A. D., may be gleaned from the writings of Plutarch and Cleomedes, the first of whom says, "The geometers think that no mountain exceeds ten stadia [about one geographic mile] in height, and no sea ten stadia in depth." And the second: "Those who doubt the sphericity of the earth on account of the hollows of the sea and the elevation of the mountains, are mistaken. There does not, in fact, exist a mountain higher than fifteen stadia, and that is also the depth of the ocean."

There was no important addition to our knowledge of the deep sea during the middle ages, and no definite attempt to provide effective means for deep-sea sounding appears to have been made until Nicolaus Causanus, who lived in the first half of the fifteenth century, invented an apparatus consisting of a hollow sphere, to which a weight was attached by means of a hook, intended to carry the sphere down through the water with a certain velocity. On touching the ground the weight became detached and the sphere ascended alone. The depth was calculated from the time the sphere was under water. This apparatus was afterward modified by Plücher and Alberti, and, in the seventeenth century, by Hooke, who substituted a piece of light wood well varnished over for the hollow sphere. Hooke's instrument was no doubt fairly accurate in shallow water, but useless in great depths, where the enormous pressure waterlogged the wood and, by materially increasing its density, greatly diminished the speed with which it rose from the bottom. When used in currents the float was carried away and the record lost.

During the period when the voyages of Columbus, Vasco da Gama, and Magellan added a hemisphere to the chart of the world and forever established the fundamental principles of all scientific geography, navigators had sounding lines of one hundred and two hundred fathoms in length, and, although they eagerly studied the oceanic phenomena revealed at the surface, the deep sea did not

engage their attention. Kircher, in his Mundus Subterraneus, gives the ideas as to the depths of the sea that were accepted in the first half of the seventeenth century, stating that "in the same manner as the highest mountains are grouped in the center of the land, so also should the greatest depths be found in the middle of the largest oceans; near the coasts with but slight elevations the depth will gradually diminish toward the shore. I say coasts with but slight elevations, for, if the shores are surrounded by high rocks, then greater depths are found. This is proved by experience on the shores of Norway, Iceland, and the islands of Flanders."

Several soundings were taken in deep water during the eighteenth century, but they were not of much value. The first at all reliable were made by Sir John Ross during his well-known arctic expedition in 1818. He brought up six pounds of mud from 1,050 fathoms in Baffin Bay, and obtained correct soundings in 1,000 fathoms in Possession Bay, finding worms and other animals in the mud procured. Sir James Clark Ross, during his antarctic expedition from 1839 to 1843, obtained satisfactory soundings of 2,425 and 2,677 fathoms in the South Atlantic, with a hempen cord. He also dredged successfully in depths of 400 fathoms.

Meanwhile, about the middle of the eighteenth century, the first definite ideas about the formation of the bottom soil began to be advanced, although there had been speculations on the formation of alluvial layers since the time of Herodotus. In 1725 Marsilli made a few observations on the bathymetric knowledge then possessed concerning the nature of the bottom of the sea. He admitted that the basin of the sea was excavated "at the time of the creation out of the same stone which we see in the strata of the earth, with the same interstices of clay to bind them together," and pointed out that we should not judge of the nature of the bottom of the basins by the materials which seamen bring up in their soundings. The dredgings almost always indicate a muddy bottom, and very rarely a rocky one, because the latter is covered with slime, sand, and sandy, earthy, and calcareous concretions, and organic matter. These substances, he said, conceal the real bottom of the sea, and have been brought there by the action of the water. Lastly, by way of explanation, he compared the bed of the sea to the inside of an old wine cask, which seems to be made of dregs of tartar although it is really of wood.

Donati's studies on the bottom of the Adriatic Sea led him to announce, about the middle of the eighteenth century, that it is hardly different from the surface of the land, and is but a prolongation of the superposed strata in the neighboring continent, the strata themselves being in the same order. The bottom of this sea is, according to him, covered with a layer formed by crusta-

ceans, testaceans, and polyps, mixed with sand, and to a great extent petrified. This crust may be seven or eight feet deep, and he attributed to this deposit, bound together with the remains of organisms and sedimentary mineral matter, the rising of the bottom of the sea, and the encroachment of the water on the coasts.

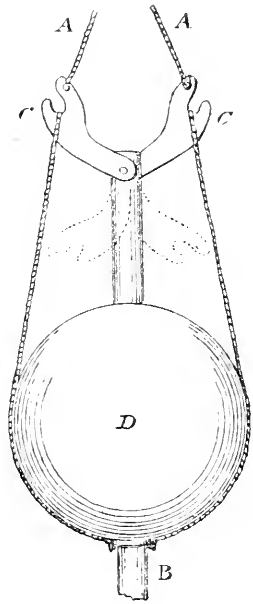
In 1836 Ehrenberg produced the first of a long series of publications relating to microscopic organisms which distinguished him as a naturalist of rare sagacity. He devoted the whole of his life to the study of microscopic organisms, to the examination of materials brought up from deep-sea soundings, and to all questions appertaining to the sea. Having discovered that the siliceous strata known as tripoli, found in various parts of the globe, are but accumulations of the skeletons of diatoms, sponges, and radiolaria, and having found living diatoms and radiolaria on the surface of the Baltic of the same species as those found in the Tertiary deposits of Sicily, and having shown that in the diatom layers of Bilin in Bohemia the siliceous deposit had, under the influence of infiltrated water, been transformed into compact opaline masses, he concluded that rocks like those which play so important a part in the terrestrial crust are still being formed on the bottom of the sea.

The investigation of the distribution of marine animals according to the depths of the sea may be said to have commenced in 1840 with Forbes's studies in the Mediterranean. He maintained that the dredgings showed the existence of distinct regions at successive depths, having each a special association of species; and remarks that the species found at the greatest depths are also found on the coast of England—concluding, therefore, that such species have a wider geographical distribution. He divided the whole range of depth occupied by marine animals into eight zones, in which animal life gradually diminished with increase of depth, until a zero was reached at about three hundred fathoms. He also supposed that plants, like animals, disappeared at a certain depth, the zero of vegetable life being at a less depth than that of animal life.

It has already been mentioned that probably the first reliable deep-sea soundings ever made were by Sir John Ross in 1818. To him is due the invention of the so-called deep-sea clam, by means of which specimens of the bottom were for the first time brought up from great depths in any quantity. This instrument was in the form of a pair of spoon-forceps, kept apart while descending, but closed by a falling weight on striking the bottom. Two separate casts were usually made, one to ascertain the depth and the other to bring up a specimen of the bottom soil.

For the development of accurate knowledge of the depths of the sea the world will ever be indebted to the genius of Midship-

man Brooke, of the United States Navy, who made the first great improvement in deep-sea sounding in 1854 by inventing a machine in which, applying Causanus's idea of disengaging a weight attached to the sounding line, the sinker was detached on striking the bottom and left behind when the tube was drawn up. The arrangement of the parts is shown in the accompanying figure. When the tube B strikes the bottom, the lines A A slack and allow the arms C C to be pulled down by the weight D. When these arms have reached the positions indicated by the dotted lines, the slings supporting the weight have slipped off, and the tube can be hauled up, bringing within it a specimen of the bottom. This implement has been improved from time to time by various officers of our own and foreign navies by changing the manner of slinging and detaching the sinker, and by adding valves to the upper and lower ends of the tube to prevent the specimen from being washed out during the rapid ascent which has been rendered possible by the use of wire sounding line and steam hoisting engines; but in all the essential features it is the same as the most successful modern sounding apparatus. The impulse given to deep-sea sounding by Brooke was seconded by the successful adaptation of pianoforte wire to use as a sounding line, in 1872, by Sir William Thomson; and within recent years soundings have been taken far and wide in all the seas by national vessels during their cruises, by vessels engaged in laying submarine cables, and by various specially organized expeditions, among which that known as the Challenger Expedition, sent out by the Government of Great Britain during the period from 1873 to 1876, stands pre-eminent. As a result of this work many of the questions which perplexed the naturalists of the middle of the present century have now been cleared away.




Many of the specimens of the bottom that were brought up in the early days of deep-sea sounding were studied through the microscopes of Ehrenberg, of Berlin, and Bailey, of West Point. Maury, who believed that there are no currents and no life at the bottom of the sea, wrote: "They all tell the same story. They teach us that the quiet of the grave reigns everywhere in the profound depths of the ocean; that the repose there is beyond the reach of wind; it is so perfect that none of the powers of earth, save only the earthquake and volcano can disturb it. The

specimens of deep-sea soundings are as pure and as free from the sand of the sea as the snowflake that falls when it is calm upon the lea is from the dust of the earth. Indeed, these soundings suggest the idea that the sea, like the snow cloud with its flakes in a calm, is always letting fall upon its bed showers of these microscopic shells: and we may readily imagine that the 'sunless wrecks' which strew its bottom are, in the process of ages, hid under this fleecy covering, presenting the rounded appearance which is seen over the body of a traveler who has perished in the snowstorm. The ocean, especially within and near the tropics, swarms with life. The remains of its myriads of moving things are conveyed by currents, and scattered and lodged in the course of time all over its bottom. The process, continued for ages, has covered the depths of the ocean as with a mantle, consisting of organisms as delicate as the macled frost and as light as the undrifted snowflake of the mountain."

Maury was right in respect to the covering of the bed of the deep sea, for, as a result of all our researches, it is found that in waters removed from the land and more than fourteen hundred fathoms in depth there is an almost unbroken layer of pteropod, globigerina, diatom, and radiolarian oozes, and red clay which occupies nearly 115,000,000 of the 143,000,000 square miles of the water surface of the globe. But he was wrong in asserting that low temperature, pressure, and the absence of light preclude the possibility of life in very deep water.

Ehrenberg held the opposite opinion with regard to the conditions of life at the bottom of the sea, as may be seen from the following extract from a letter which he wrote to Maury in 1857: "The other argument for life in the deep which I have established is the surprising quantity of new forms which are wanting in other parts of the sea. If the bottom were nothing but the sediment of the troubled sea, like the fall of snow in the air, and if the biolithic curves of the bottom were nothing else than the product of the currents of the sea which heap up the flakes, similarly to the glaciers, there would *necessarily* be much less of unknown and peculiar forms in the depths. The surface and the borders of the sea are much more productive and much more extended than the depths; hence the forms peculiar to the depths should not be perceived. The great quantity of peculiar forms and of soft bodies existing in the innumerable carapaces, accompanied by the observation of the number of unknowns, *increasing with the depth*—these are the arguments which seem to me to hold firmly to the opinion of stationary life at the bottom of the deep sea."

It would appear to have been definitely established by the researches of the last fifty years that life in some of its many forms is universally distributed throughout the ocean. Not only in the

shallower waters near coasts, but even in the greater depths of all oceans, animal life is exceedingly abundant. A trawling in a depth of over a mile yielded two hundred specimens of animals belonging to seventy-nine species and fifty-five genera. A trawling in a depth of about three miles yielded over fifty specimens belonging to twenty-seven species and twenty-five genera. Even in depths of four miles fishes and animals belonging to all the chief invertebrate groups have been procured, and in a sample of ooze from nearly five miles and a quarter there was evidence to the naturalists of the Challenger that living creatures could exist at that depth.

Recent oceanographic researches have also established beyond doubt that while in great depths the water is not subjected to the influence of superficial movements like waves, tides, and swift currents, there is an extremely slow movement, in striking contrast with the agitation of the surface water. Although the movement at the bottom is so slow that the ordinary means of measuring currents can not be applied accurately to them, the thermometer furnishes an indirect means of ascertaining their existence. Water is a very bad conductor of heat, and consequently a body of water at a given temperature passing into a region where the temperature conditions are different retains for a long time, and without much change, its original temperature. To illustrate: The bottom temperature near Fernando do Noronha, almost under the equator, is 0·2° C., or close upon the freezing point; it is obvious that this temperature was not acquired at the equator, where the mean annual temperature of the surface layer of the water is 21° C., and the mean normal temperature of the crust of the earth not lower than 8° C. The water must therefore have come from a place where the conditions were such as to give it a freezing temperature; and not only must it have come from such a place, but the supply must be continually renewed, however slowly, for otherwise its temperature would gradually rise by conduction and mixture. Across the whole of the North Atlantic the bottom temperature is considerably higher, so that the cold water can not be coming from that direction; on the other hand, we can trace a band of water at a like temperature at nearly the same depth continuously to the Antarctic Sea, where the conditions are normally such as to impart to it this low temperature. There seems, therefore, to be no doubt that there is a current from the antarctic to the equator along the bottom of the South Atlantic.

From the millions of reliable deep-sea soundings that have been made during the last forty years the more general features of the bathymetric chart of the world have been firmly established; and the ancient idea, derived chiefly from a supposed

physical relation, that the depths of the sea are about equal to the heights of the mountains, has given place to exact notions as to the depths as well as the heights.

The greatest known depths that have been reliably sounded in the different oceans are given in the following list:

| | Latitude. | Longitude. | Depth in fathoms. |
|---|---|---|---|
| North Atlantic Ocean | 19° 39′ N. | 66° 26′ W. | 4,561 |
| South Atlantic Ocean | 19° 55′ S. | 24° 50′ W. | 3,284 |
| North Sea (Skagerack) | 58° 12′ N. | 9° 30′ E. | 442 |
| Baltic Sea | 58° 37′ N. | 18° 30′ E. | 233 |
| Mediterranean Sea | 35° 45′ N. | 21° 46′ E. | 2,405 |
| Black Sea | 42° 55′ N. | 33° 18′ E. | 1,431 |
| Caribbean Sea | 19° 0′ N. | 81° 10′ W. | 3,427 |
| Indian Ocean | 11° 22′ S. | 116° 50′ E. | 3,393 |
| North Pacific Ocean | 44° 55′ N. | 152° 26′ E. | 4,655 |
| South Pacific Ocean | 24° 37′ S. | 175° 08′ W. | 4,428 |
| Bering Sea | 54° 30′ N. | 175° 32′ W. | 2,146 |
| Sea of Japan | 38° 30′ N. | 135° 0′ N. | 1,640 |
| China Sea | 17° 15′ N. | 118° 50′ E. | 2,350 |
| Sulu Sea | 8° 32′ N. | 121° 55′ E. | 2,549 |
| Celebes Sea | 4° 16′ N. | 124° 02′ E. | 2,794 |
| Banda Sea | 5° 24′ S. | 130° 37′ E. | 2,799 |
| Flores Sea | 7° 43′ S. | 120° 26′ E. | 2,799 |
| Arctic Ocean | 78° 05′ N. | 2° 30′ W. | 2,469 |
| Antarctic Ocean | 62° 26′ S. | 95° 44′ E. | 1,975 |

## THE CULTIVATION OF HUMANE IDEAS AND FEELINGS.*

By Prof. WESLEY MILLS, M. A., M. D.,
MC GILL UNIVERSITY, MONTREAL.

THE main object of every society for the prevention of cruelty to animals I take to be the establishment of right feelings toward our speechless fellow-creatures. But feeling, to be correct, strong, and abiding, must be based on sound conceptions of the nature of that toward which it is exercised. So long as any individual believes that another wishes to injure him, so long will he find it most difficult to entertain kindly feelings toward the man that he deems his enemy; but let it appear that he has entirely misunderstood the motive and actions of the individual in question—that instead of an enemy he proves to be a friend—and the whole current of feeling is changed. Thus would it be, in my opinion, with thousands of people if they could be made to see animals in their true light.

Glancing at historical and national views of animal life, we find at all periods widely different conceptions, and consequently

* An Address before the American Humane Association, Philadelphia, October 27, 1892.

feelings, in regard to some of our domestic animals. A certain animal regarded as a fit subject for contempt by some peoples has been an object of worship, or something akin to it, by others: hence it is not surprising that the lot of such animals has been very different in some parts of the world as compared with others. To illustrate this we need go no further than the universally distributed dog and cat. In the East the dog is rarely other than a homeless, despised outcast. In Europe generally he is a member of the family. But it is to Great Britain especially that we look to find all our domestic animals in the highest perfection, and cherished with feelings of peculiar regard. In Britain it is contrary to law to hitch a dog, however large and strong, to a cart to draw even a small child, while in Germany dogs may be seen used as beasts of burden in all the large cities. In no part of the world are the good qualities of dogs so appreciated and valued as in Great Britain; hence it is not at all inexplicable that cruelty to the dog and other animals is there comparatively rare.

It may safely be said that never before in civilized countries were animals—and especially our domestic animals—treated so well, because never before were they so thoroughly understood. To what is this to be attributed? Not alone to the spread of kindlier feelings and better principles generally, but largely to the advance of science. There was a time, well within the recollection of persons not yet old, when man, we were told by those to whom we looked for light and guidance, stood utterly apart from all else in the universe as the one being in whom the Creator specially, and we might say solely, delighted, and for whose benefit every other object, animate and inanimate, existed. How natural, then, for man to believe that animals, as such, had few if any rights!

The one test to which many persons naturally enough brought every animal was just this: Is the creature of any *use* whatever to man? If not, then it was held that it simply cumbered the ground. People, it is true, admitted that man was an animal; but they did not realize what this expression meant, or did not accept it in its full significance. To them man was an "animal," but not like the others. He was too exalted to have any more than the common principle of life. Men could not realize then as now that mind and body are so closely related that for every mental process there must be a corresponding physical correlative. But this once being admitted it became possible to understand that animals below man may have minds whose processes are akin to ours. The question then became, not have animals minds, but what sort of minds. Wherein does animal intelligence in the widest sense differ from human intelligence? As soon as man himself became better understood it was plain that his feelings were, on certain

planes, parallel with groups of animals much lower in the scale generally. To them pleasures and pains were just as real as they were similar to those of human beings.

I suggest that these most important advances are owing chiefly to the progress and the diffusion of scientific knowledge and the scientific spirit. The doctrine of organic evolution published by Darwin over thirty years ago at once offered to man a broader kinship than he had previously been able to comprehend. In my opinion the importance of this conception will, for a right understanding of the relations of man and other animals, outweigh all others, because it will bring us to see that, with a common origin, there must always remain numerous similarities of nature.

But, without taking advantage of the doctrine of evolution, it has become apparent that the claim for man of a nature entirely distinct and different from that of other forms of life is baseless. Gradually, from many different quarters, this conception of similarity of nature is spreading among the masses; and the friend of animals can not do better than encourage people to dwell upon the resemblances rather than the differences between the highest and the lower grades of animal life. It will be readily perceived, then, that my conviction is that we shall best advance the cause we have at heart—the humane treatment of our animals—by spreading sound views of their nature, and in that keeping prominent the resemblances to man rather than the differences from him, many of them questionable, at all events as to kind.

Inasmuch as science has done more than all other agencies in dissipating man's prejudices and freeing the mind from erroneous and enslaving views, it will be wise for all societies with a humane object to think well before in any way interfering with scientific investigations of any kind. Without research the true nature of those diseases which afflict man and the lower animals can not be known.

With many persons dogs and hydrophobia are closely associated mentally, and I recently read an article in which the author spoke of the dog as the "breeder of hydrophobia." The societies will do good by publishing actual statistics and other details bearing on the nature of this dreaded disease. I have also read arguments for the complete extirpation of dogs based on the fact that some sheep were worried. The plain preventive for rabies is the proper care and management of dogs; and for sheep-worrying, the confinement of dogs at night, which would be, indeed, a proper proceeding if no sheep existed. A roaming dog is no more desirable than a human tramp; but no one has advocated the destruction of the human race to get rid of tramps. In attempting to spread sound views in regard to diseases that are common to man and our domestic animals, such as rabies, indirectly much

information will be given to the public about the care of dogs, with a view to avoiding conditions that simulate this terrible malady. The "mad dog" of the streets is, we know, rarely rabid, and usually only needs a little judicious and kindly assistance to restore him to health. It is just about as reasonable to pounce on and kill a human being that falls in an epileptic fit, as the majority of the dogs that are attacked and killed by an excited crowd.

Above all, the public needs enlightenment regarding the true nature of animals. When that is complete and thorough, right feelings toward them will spring up in the larger proportion of people. I would especially direct attention to the education of children in and out of school on this subject. It should be held before a child as a more cowardly thing to abuse a defenseless animal than one of its own species. But this will not weigh much with the child if all it hears tends to belittle the creatures by which it is surrounded, and to exalt man beyond all measure. I should begin with very young children by pointing to similarities of structure and function between themselves and the family cat or dog. They have eyes, ears, tongues, etc.; they see, hear, taste, feel pain, and experience pleasure just as children do; therefore, let us recognize their rights, avoid giving them pain, and increase their pleasures. I strongly advocate each family having some one animal, at least, to be brought up with the household to some extent, whether it be bird, cat, or dog. But, on the other hand, it seems to me to be a great mistake to introduce any animal as a mere toy or plaything for very young children. Such a proceeding rather tends to encourage cruelty.

It is of great importance for the education of the public mind that fine specimens of animals be exhibited. All shows for our domestic animals are worthy of encouragement as educators. Many a person that regards the ordinary mongrel dogs of the street with indifference, if not aversion, has his views and feelings changed when he attends a dog show, with its numerous specimens of fine, pure-bred animals; and the same may be said of horse, cattle, and poultry shows. The æsthetic has a very great influence in our age. We devote a large share of our energies to securing the gratification of our sense of the beautiful. It will be judicious, therefore, to present the beautiful in animals to the public. For this reason, again, exhibitions of superior specimens of domestic animals, zoölogical gardens, museums, and kindred institutions prepare the public mind to appreciate animals more; and, as I am endeavoring to show, to understand and to admire are usually necessary steps to the generation of humane feelings toward the creatures with which we come in contact.

Once establish the proper feelings, and fitting conduct is likely to follow; but before these feelings arise we must have right con-

ceptions of man's relations, if not relationship, to the animal kingdom.

While many persons are ready to admit that, so far as physical organization is concerned, man and other animals are on the one plane, they either do not believe in any likeness beyond this, or more probably they have never examined the subject.

It is not unlikely that the great majority of persons have not devoted a half hour of their lives, taken altogether, to any thought upon such a subject. It has been taken for granted that man is on one plane of intellect and feeling, and all other animals are so much below him that their acts are not commonly regarded as other than the result of instinct, a sort of blind impulse, so that they are not regarded as showing at all those qualities which we term mental, much less moral ones. Even educated persons have but vague conceptions on the subject of animal intelligence. The publications of many of the humane societies bearing on animal intelligence must have done a vast amount of good in dissipating ignorance and prejudice.

We have in Montreal, in connection with the Faculty of Comparative Medicine and Veterinary Science of McGill University, a society for the study of comparative psychology—the only institution of the kind with which I am acquainted. It has been in existence now six years.

A brief account of the proceedings of each meeting is published in the daily press of the city, and I have reason to believe that the association has in this way alone helped considerably the cause of the lower animals. The Montreal Association for the Prevention of Cruelty to Animals has received and circulated large numbers of copies of several of the papers read before this society for the study of animal intelligence.

I suggest that if the interest of teachers—especially the heads of schools—can be secured, some steps may be taken in leading the young to entertain correct views and feelings toward the lower animals. The keynote should be: They are our fellow-creatures; in some, but not all respects, our "poor relations"; to be guarded and assisted, but also to be respected; for in not a few directions they are superior to ourselves. Let this spirit get into schools and families, and but little actual formal teaching will be required to accomplish the end in view. Actions on the part of elders in this, as in other cases, speak louder than words.

Of course, now, and for a long time to come, the ignorant, the lowly organized, and the depraved will maltreat animals; and they must be appealed to in a way that is deterrent—that is, by punishment. But the sooner we can establish a strong and correct public feeling on the subject of the rights and relations of animals, the more effectually will cruelty be prevented; and when

it does occur, be detected and punished. All cases of prosecution should be published, on account not only of its preventive effect, but because it strengthens public sentiment.

The cause will be hindered by mawkish sentiment, interference to an undue degree in slight cases, while neglecting great and widespread injustice, or positive wrong, toward our faithful dumb friends. In spreading sound ideas in regard to animals; in correcting generally admitted and great cruelties; in providing temporary homes for lost and stray animals; by encouraging, directly or indirectly, scientific research in biology, especially on the diseases common to man and our domestic animals; in contributing to the investigation of animal intelligence—we have, in addition to many other lines of effort, large and worthy fields of endeavor for the improvement of the condition of things in the world in which we live, both for man and his fellow-creatures, lower in the scale, it is true, but withal very admirable.

## THE OSWEGO STATE NORMAL SCHOOL.

By Prof. WILLIAM M. ABER.

TO-DAY, in the quiet, old city of Oswego, N. Y., stands a school whose influence has extended throughout the land. At its head is its founder, Dr. E. A. Sheldon: the school is his life work.

In 1848 Mr. Sheldon, a young man of twenty-four, then a resident of Oswego, felt moved to study somewhat into the condition of the poor of that city. Their ignorance and misery excited profound pity. Influential friends were enlisted, an "Orphan and Free School Association" was formed, a schoolroom provided, and a teacher sought. To his surprise, he found that he must teach the school or the enterprise would be abandoned. For salary he asked the estimated cost of his living, two hundred and seventy-five dollars per year, and received three hundred dollars. In the basement of an old church, the inexperienced young teacher was brought face to face with one hundred and twenty wild boys and girls of from five to twenty-one. These he held in order and kept at work by insight, love, and patience—those potent exorcisers of evil spirits.

From this movement, though against strenuous opposition, sprang the free and graded schools of Oswego, which were organized by Mr. Sheldon in 1853. As a superintendent of schools he might have ended his days, had he not possessed qualities of mind and heart which led him to turn from easy, routine work and encounter toils and dangers to find or make a better way. As machines for securing from the pupils the learning, *memoriter*, of

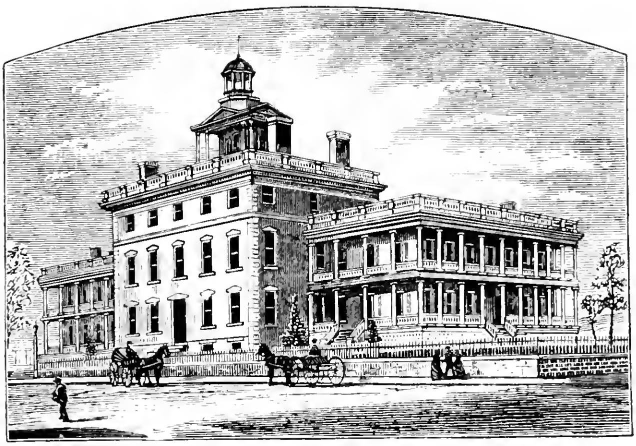
so many pages per day, and from the teachers recitation-hearing, marking, and reporting, his schools were eminently successful. Teachers, pupils, and patrons neither knew nor desired anything better; but that sympathy with childhood which had led Mr. Sheldon into this work was not satisfied with these poor results. Five years of growing dissatisfaction with the current range of

E. A. Sheldon.

subjects and methods of instruction had culminated in a determination to prepare some books and charts for himself, when a visit to Toronto revealed the object of his search. He saw there in the National Museum, *though not used in their own schools*, collections of appliances employed abroad—notably in the Home and Colonial Training School in London. Evidently the seed sown by this school had not found in Toronto so good a soil as in the mind of this Yankee schoolmaster. From this visit he returned with the delight of a discoverer of a new world, laden with charts, books, balls, cards, pictures of animals, building blocks,

cocoons, cotton bolls, samples of grain, and specimens of pottery and glass.

In 1859 a new course for the primary schools was introduced at Oswego, in which lessons on form, color, size, weight, animals, plants, the human body, and moral instruction were prominent. But his teachers knew little about the subject matter of such lessons, and less about methods of teaching them. The superintendent was forced to become the teacher and trainer of his teachers. Without training himself, he sadly felt the inadequacy of his instructions, and determined to try to obtain a training teacher from



Old Normal School Building.

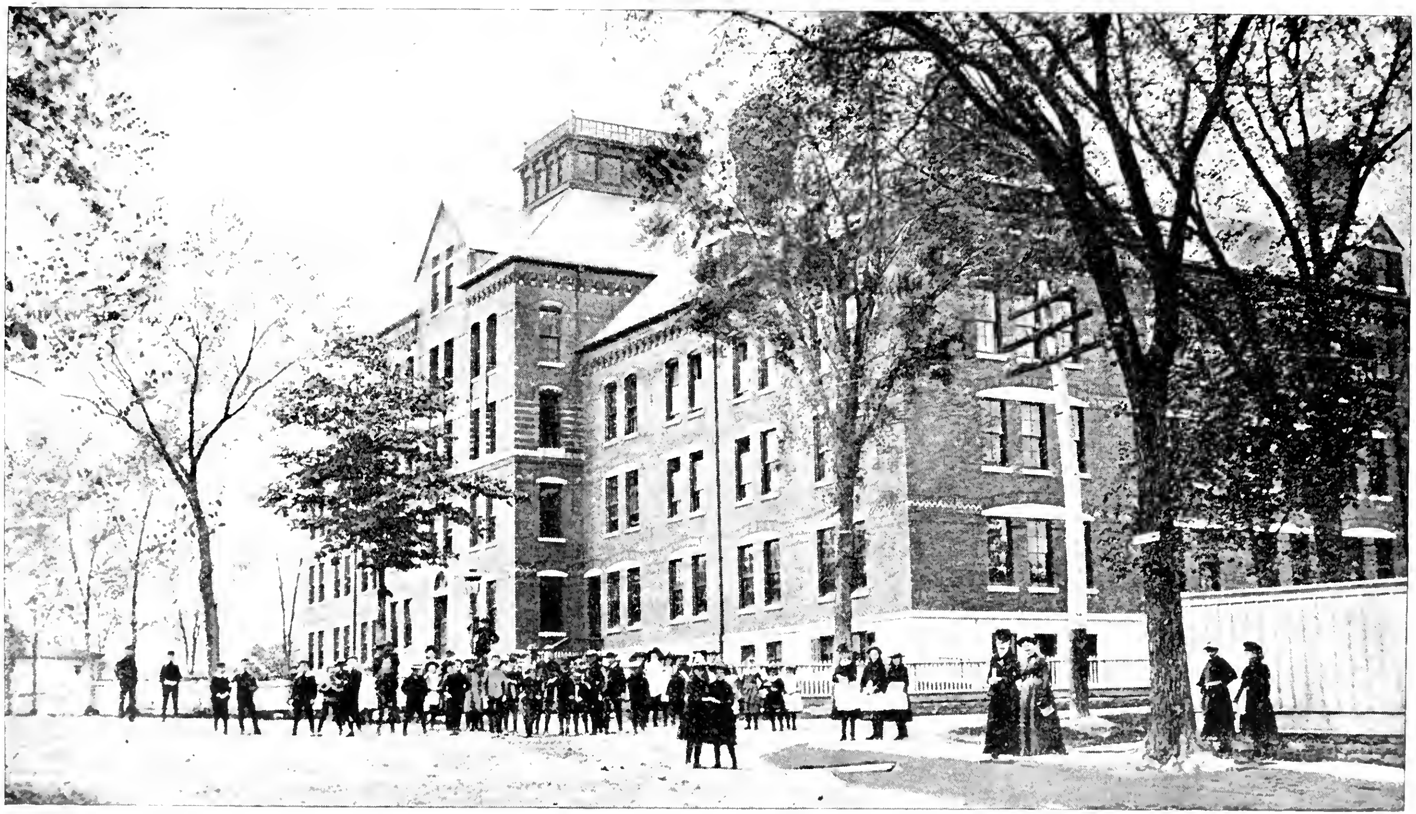
the Home and Colonial School. The Board of Education consented, "on condition of its not costing the city a single cent." To assist in providing the means, some of his teachers resigned, for one year, half their salaries, which ranged from three to five hundred dollars. Their names should be recorded among the founders of the school, and written in letters of gold on its walls. To begin this work, Miss M. E. M. Jones was obtained, for one year, from the Home and Colonial School. After school hours each day, Mr. Sheldon, his most interested teachers, and a few from abroad, sat for two hours in a small, obscure room to receive the instruction which had been brought from over the sea at so much personal sacrifice. For one year these men and women became as little children, that they might enter and win the kingdom of childhood through the door opened by Pestalozzi, for Miss Jones was a disciple of that master. The work thus begun was continued by some of her pupils, and by Prof. Hermann Krüsi, who also had taught in the Home and Colonial, and was a son of one of Pestalozzi's most trusted helpers.

For two years, this training class was maintained by the city.

In 1863 it was adopted by the State, and a grant of three thousand dollars per year was made for its support, on condition of the city's furnishing the necessary buildings and accommodations, and of not less than fifty teachers designing to teach in the common schools of the State receiving free tuition each year. These persons were to be recommended by county commissioners or city superintendents and appointed by the State Superintendent. In 1865 a building was purchased and fitted up by the Oswego Board of Education at a cost of twenty-six thousand dollars. In 1866 a general act was passed by the Legislature, which provided for four additional normal and training schools in various parts of the State, to be governed by local boards, appointed and removable at will by the State Superintendent, and supported by an annual grant of twelve thousand dollars each. On March 27, 1867, the building provided by Oswego was accepted by the State. With the appointment of a local board of thirteen, the Training School's connection with the city schools ended, except that which necessarily arose from the Practice School. So the city teachers' class had in six years grown into a State Normal and Training School, and had produced four other schools fashioned in its own image.*

The development from a training class for the primary teachers of one city to a school for the training of teachers for all grades and for all parts of the State, necessitated an enlargement of the curriculum. The one-year course was enlarged to courses of two, three, and four years. The first covered the field of instruction below the high schools; the second included high-school work; and the third added Latin and Greek, with German and French as an alternative for Greek. The last year of each course was devoted to professional work. In these enlargements there was no departure from the original plan. Instruction in the subject matter to be taught, in the history and philosophy of education, in psychology, in general methods of teaching, and methods in detail for special subjects, and practice in teaching have from the first characterized the Oswego school—characteristics which have been reproduced in most of the normal schools of the country. These enlargements were bitterly opposed by the private school interests of the State, represented in the academies; but they were forced upon the normal schools by two facts: most of the appointees were too imperfectly instructed in the subjects to enter at once upon the discussion of methods of teaching them; and if the schools had rejected all such appointees, their duty of furnishing teachers for the public schools of the State would have

* The Normal School at Albany already existed, but had been organized on a different plan.



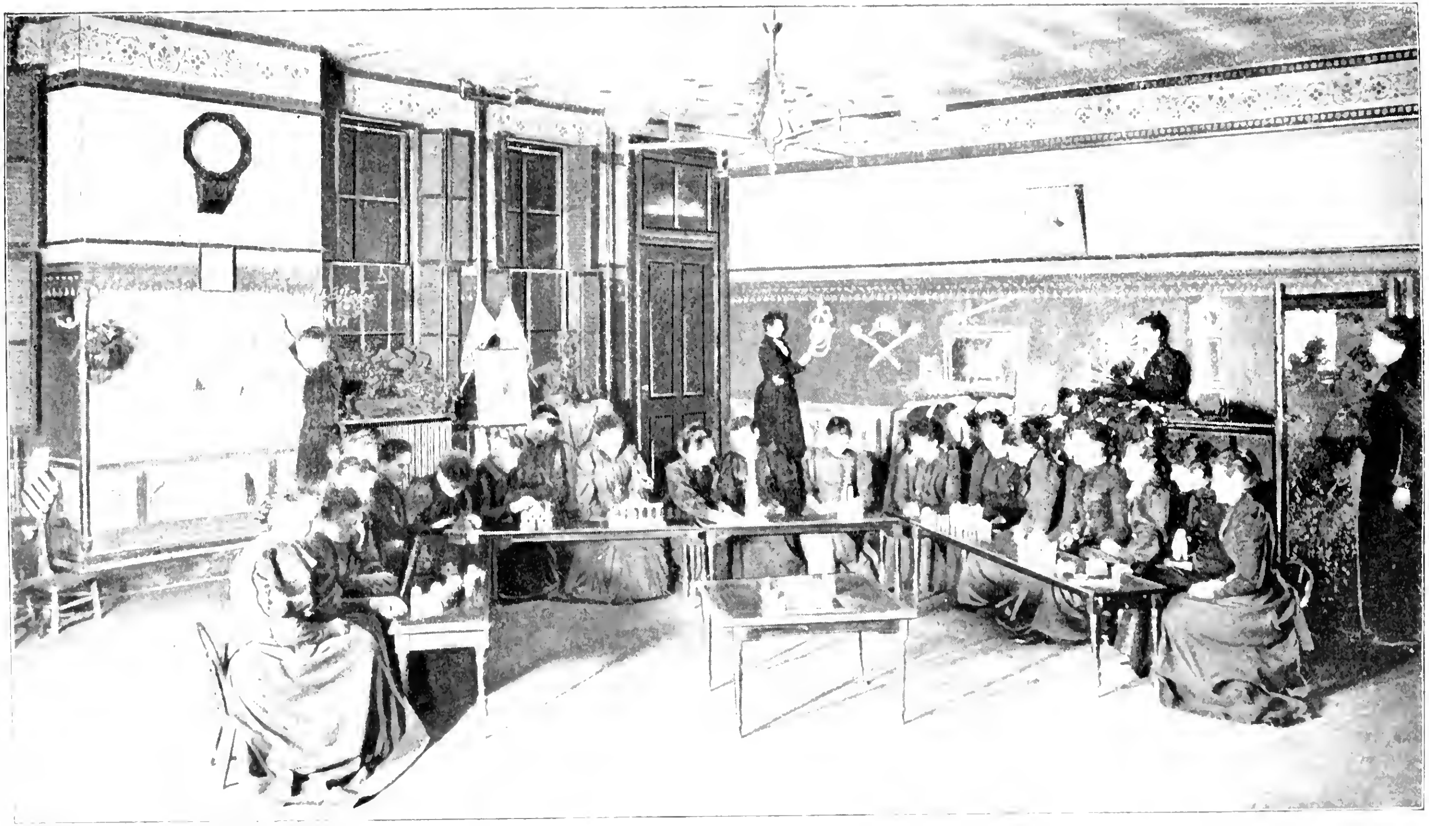
Oswego State Normal School.

been so unfulfilled as to have imperiled their very existence. New York State makes her normal-school diplomas valid as life certificates, pays one half the railway fares of State appointees, and furnishes text-books free to all. Pupils from other States were formerly admitted free, but now pay a tuition of forty dollars per year. In 1892 the two years' course was dropped, and at present the State Normal Schools have three courses—an English course of three years, and classical and scientific courses of four years.

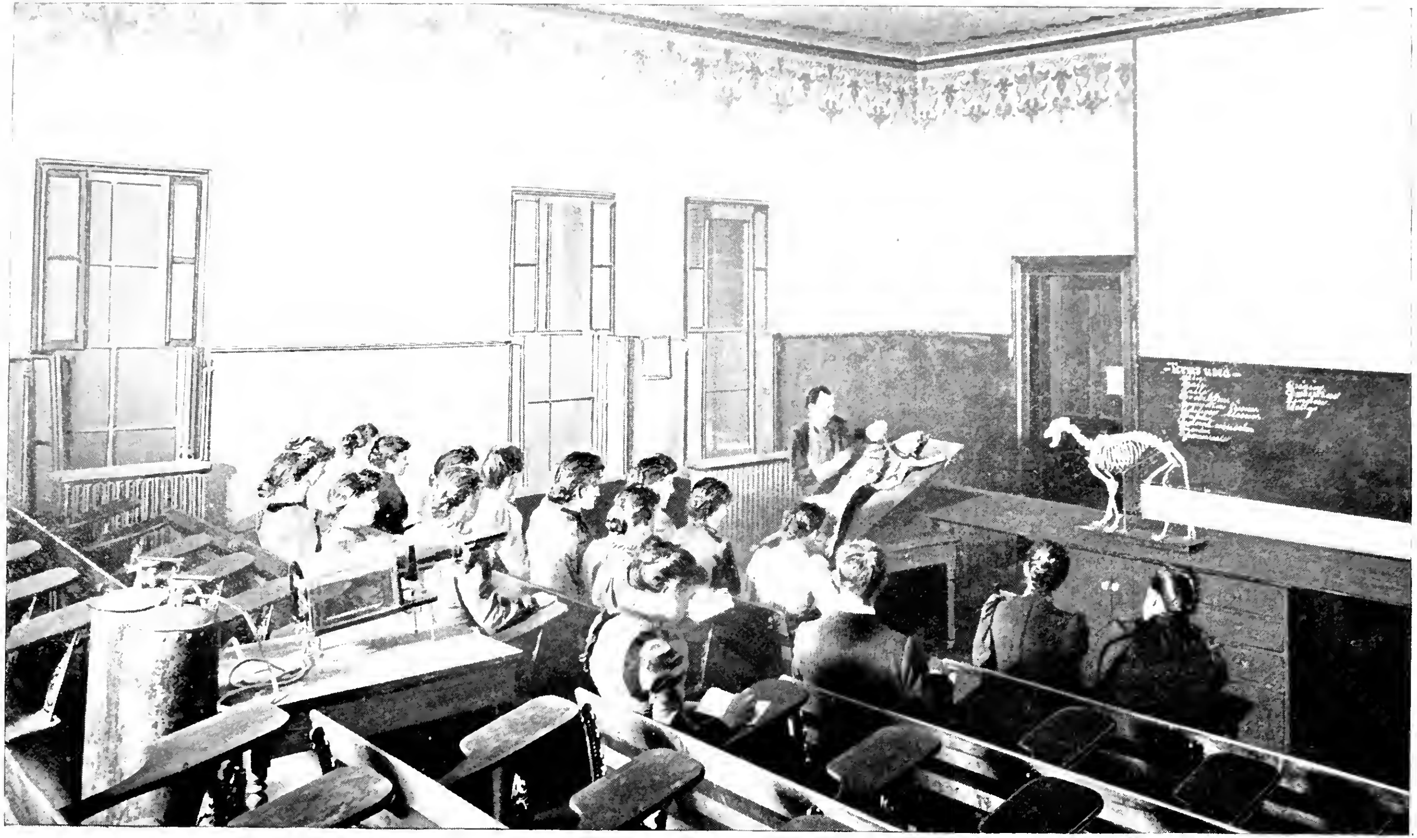
In 1890 the Oswego school decided to discontinue instruction in the ancient and modern languages "when the pupils already entered for these subjects shall have finished their courses"; but diplomas for the classical and scientific courses will be given to students who possess the required knowledge. This departure was made because Dr. Sheldon became convinced that more could be accomplished for the public schools by concentrating the energy, time, and money required for these linguistic studies on advanced academic and professional work on the lines of the English course. In lieu of these languages, the Oswego school now offers three one-year post-graduate courses:—advanced instruction in natural science, psychology, history, and English, and practice teaching in higher English and science subjects; kindergarten training, and special training for primary teaching; and preparation of teachers for teaching in training schools. For the kindergarten work a diploma is given: for each of the other courses a certificate testifying to the extra work and qualifications.

To keep pace with these various changes, the faculty of the school has been increased from six to fifteen persons; the annual appropriation raised from \$3,000 to \$21,000; and in 1879 a new building was provided by the State at a cost of \$56,000. This building (see cut) stands on the summit of a ridge rising westward from the Oswego River. It forms three sides of an oblong, with a south front one hundred and ninety feet, an east front one hundred and thirty-five feet, and a west front one hundred and twenty-two feet. In its construction, exterior form and ornament were sacrificed for interior convenience and furnishing. It gives more recitation room and laboratory space, and is better equipped with appliances for the best methods of study and professional training, than some normal-school buildings of twice its cost. Arrangements for heat, light, and ventilation are excellent. On the first floor are the general offices and waiting rooms, the kindergarten and practice school; on the second, the assembly hall, library, reading room, and general recitation rooms; on the third, literary society rooms, scientific laboratories, and lecture room; and on the fourth, an art room.

The kindergarten is domiciled in the east end of the front, in a charming room, whose adornments and work make a fairyland



Kindergarten.



Physical Laboratory.

through which the little ones enter school life with fearless, happy steps. As the visitor watches the little ones at play, weaving bright colors, building with blocks, or molding clay into forms surpassing in interest even the mud pies of his childhood, he may sigh for his own first day at school. The writer's is an indelible memory. In a rough stone house, with a forest in the rear and a swamp in front—land of more value could not be afforded—he sat for hours, with dangling feet, on a backless slab bench, until called up to receive at the master's knees, from a tattered primer, his first lesson,—looking at and calling the names of queer marks whose appearance was not interesting, and whose use was not known. Fortunate children, for whose kindly and wise guidance over the threshold of education men and women of great minds and hearts have labored, will you, as actors on the stage of life, be wiser and better than this generation?

The practice school has three large assembly rooms and twenty recitation rooms. The assembly rooms have lofty ceilings and great windows which preach the gospel of good air and sunshine, choice products of the children's work adorn their walls, and libraries for the children's use are attractive features. The school comprises from four to five hundred children of the primary, junior, and senior grades. Each grade is divided into classes of fifteen to twenty pupils. Each class is assigned its own room and a teacher from the normal class which has reached the point of practice teaching—the last twenty weeks of the courses. Each of the rooms is an independent school, for whose discipline and instruction the practicing teacher is primarily responsible. One of these teachers has for ten weeks a primary class and for ten weeks a junior or senior class; and the conditions are much like those which a teacher will have in a school of his own. The work of the same grades in the other schools of the city is done; and, in addition, extra work in drawing, color, form, work in modeling, parquetry, folding, cutting, sewing, and shop work with carpenter's tools. Drawing and modeling are extensively applied in the study of geography, plants, and animals. Each class room is adorned with the best work of its children: and ample blackboards give space for work in number, language, drawing, etc. In each is a cabinet to whose shelves field, forest, and factory have furnished treasures which delight and instruct the children. As these cabinets are constantly growing by the contributions of pupils and teachers, they have a future of great possibilities. They are all descendants of that little cabinet stored with the spoils of the Toronto visit.

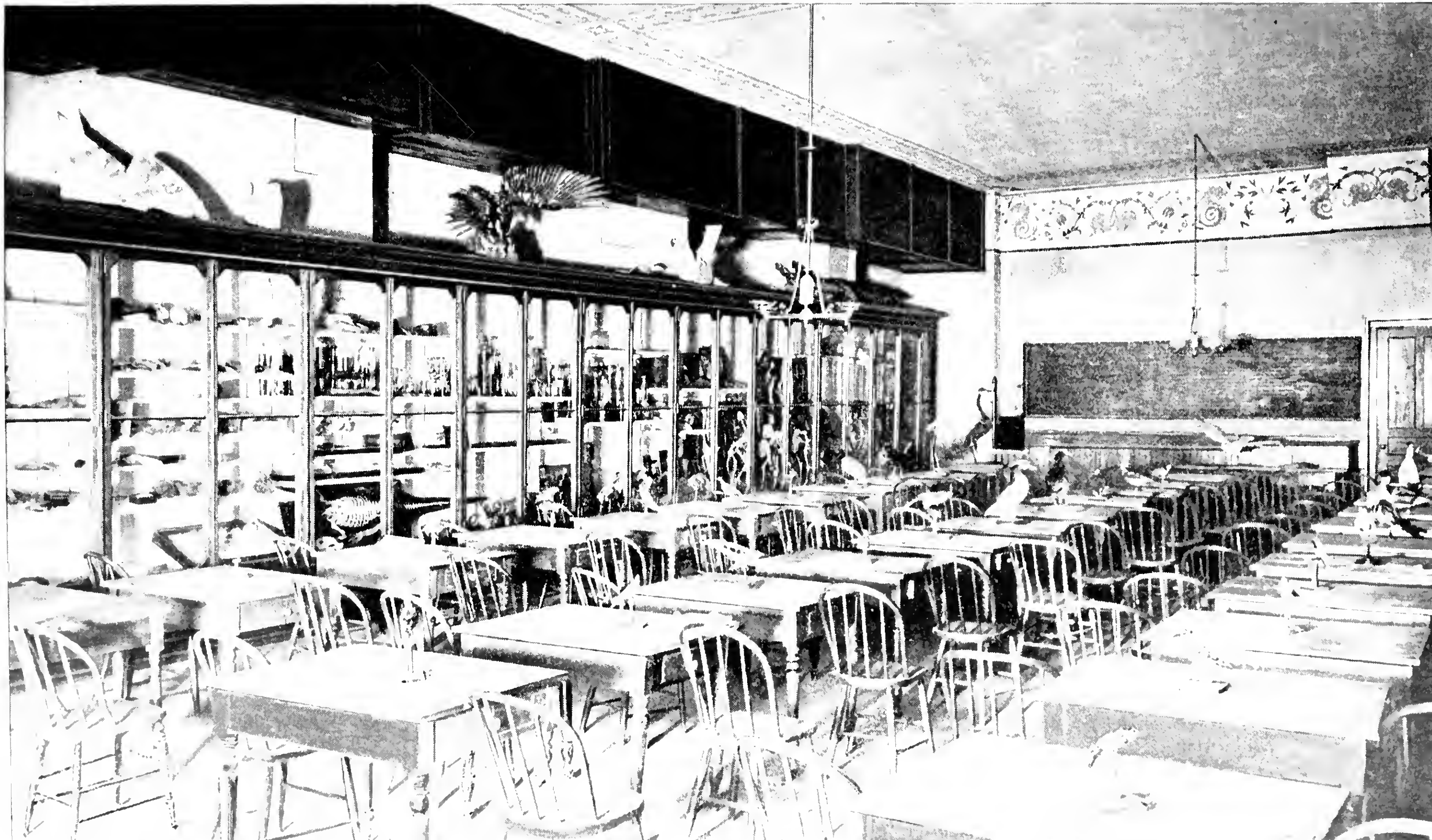
The whole collection of little schools is under the charge of five permanent critic teachers upon whom the tone and character of the whole depend, and who have the ultimate responsibility for

the welfare and progress of the children. To attempt to give, in this article, details as to the methods of securing real practice teaching, and yet conserve the interests of the children, is not practicable. That these objects are attained is evidenced by two facts,—the practice school is popular with the city patrons, and the term of practice work is generally regarded by Oswego graduates as the most valuable in their entire course. It is justly so regarded; for five months of teaching under searching but kindly and constructive criticism may be worth more than years of unaided experience. The critic teachers, while employees of the city Board of Education and responsible to them for the discipline and progress of the city pupils, are chosen and nominated by the State Normal School authorities, and are responsible to them for the normal practice teachers. This arrangement gives opportunity for difficulty and friction; but there has been little serious trouble at Oswego, a fact which speaks volumes for the good sense and tact of all concerned. The executive ability and teaching power required to drill a succession of inexperienced teachers, and during this process to work through these teachers the same or better discipline and teaching than prevails in the other city schools, can be better imagined than described. Whether the saying, "A teacher is born and not made," is true in all branches of the profession or not, it certainly is true of the critic teachers of a great practice school.

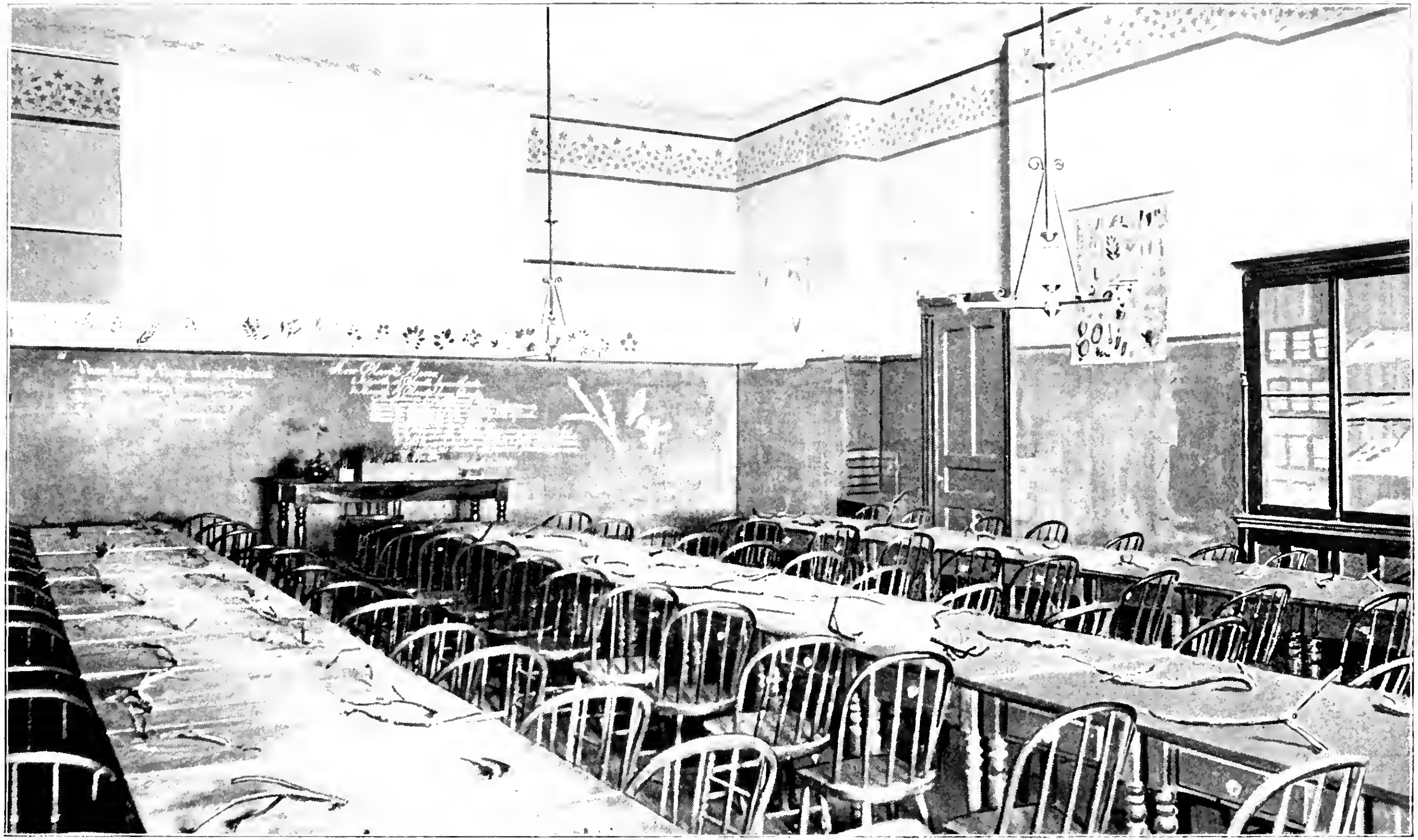
On the second floor of the building are eight recitation rooms, seating from fifty to one hundred students, devoted to mathematics, language, history, etc., and supplied with maps, charts, models, ample blackboards, and abundant light. The reading room and library on this floor have the standard periodicals and well-selected books. The visitor can not forbear the wish that some of the thousands yearly wasted by New York State could be used to increase this library; yet smallness is not an unmixed ill for a school library if the books are the best of their kind, and the limited number secures concentration of attention and thorough acquaintance. The Oswego School Library is supplemented by the City Library, whose volumes are accessible to the normal students.

The Normal Assembly Hall occupies the entire upper portion of the west wing. This wing, although of the same height as the main part of the building, is divided into but two stories above the gymnasium, thus securing extra height of ceiling for the assembly rooms of the practice school below and for the Normal Hall above. This hall is sixty-eight by seventy-six feet, seated for four hundred students, and has a capacity for three hundred additional seats on public occasions; it has large windows on three sides, and plain but tasteful coloring and decoration.

The third floor is the domain of the natural-science department



Zoölogical Laboratory.



Botanical Laboratory.

whose laboratories and lecture rooms occupy almost the whole space. The zoölogical laboratory is at the western end of the front, the mineralogical and geological at the eastern, and between them are the physical laboratory, storerooms, and lecture rooms for these sciences. The botanical and chemical laboratories are in the east wing. The zoölogical laboratory—extending thirty-two by fifty-six feet, flooded with light by a row of southern windows, lined on its northern side by spacious glass-fronted cases of specimens, at its eastern end a large tank for the storage of working materials, on the floor tables, and along the southern side a broad shelf, sufficient in all to furnish room for a hundred workers—wins the heart of the zoölogist. It has a full supply of dissecting apparatus and small microscopes for elementary work, and a fair equipment of large microscopes with accessories for more advanced work. The botanical laboratory is twenty-eight by forty feet. The other laboratories furnish working facilities for forty pupils each. The furnishing of the chemical laboratory is noteworthy for the convenience of the tables, apparatus, and water supply. In the largeness and fineness of the home provided for the natural sciences in this building, as compared with the crowding of these subjects into two or three small rooms in some recently erected normal-school buildings, there is a fit expression of Oswego educational ideas.

The art room on the fourth floor is forty-four by fifty-two feet, admirably lighted, and furnished with fine facilities for teaching drawing. Two of the three literary societies of the school—the Athenean and Adelphi—have private rooms neatly fitted up and furnished by themselves. The rhetorical and literary work of the school is largely done in connection with these societies. The Adelphi and Athenean lay out their own work and conduct their business in their own way. Alternately, about once in two weeks, they give public exercises in the Normal Hall. The Keystone, which embraces the lower classes, is in charge of members of the faculty and occasionally gives a public exercise.

On the ground floor is the workshop, provided with engine, lathes, circular saws, tools, benches, and facilities for various kinds of woodwork. In this the normal students learn to make the simpler pieces of scientific and other apparatus, and get some skill in using tools. In the class in familiar science each pupil constructs his own apparatus for illustrations and thus becomes provided with the necessary apparatus for teaching the elements of science in public schools. A room for clay modeling and one for free-hand drawing is also supplied for the manual training work. The Normal School Gymnasium is on the ground floor of the west wing. Daily exercise is required of all students, and is considered important, both for its immediate effects upon health and

comeliness, and for instruction in methods of physical training. The gymnasium is large and well equipped, and was until recently under the charge of Dr. Mary V. Lee, a physician who was a specialist in physical training and made much use of the Delsarte system. Her recent, untimely death has left the department in charge of one of her pupils.

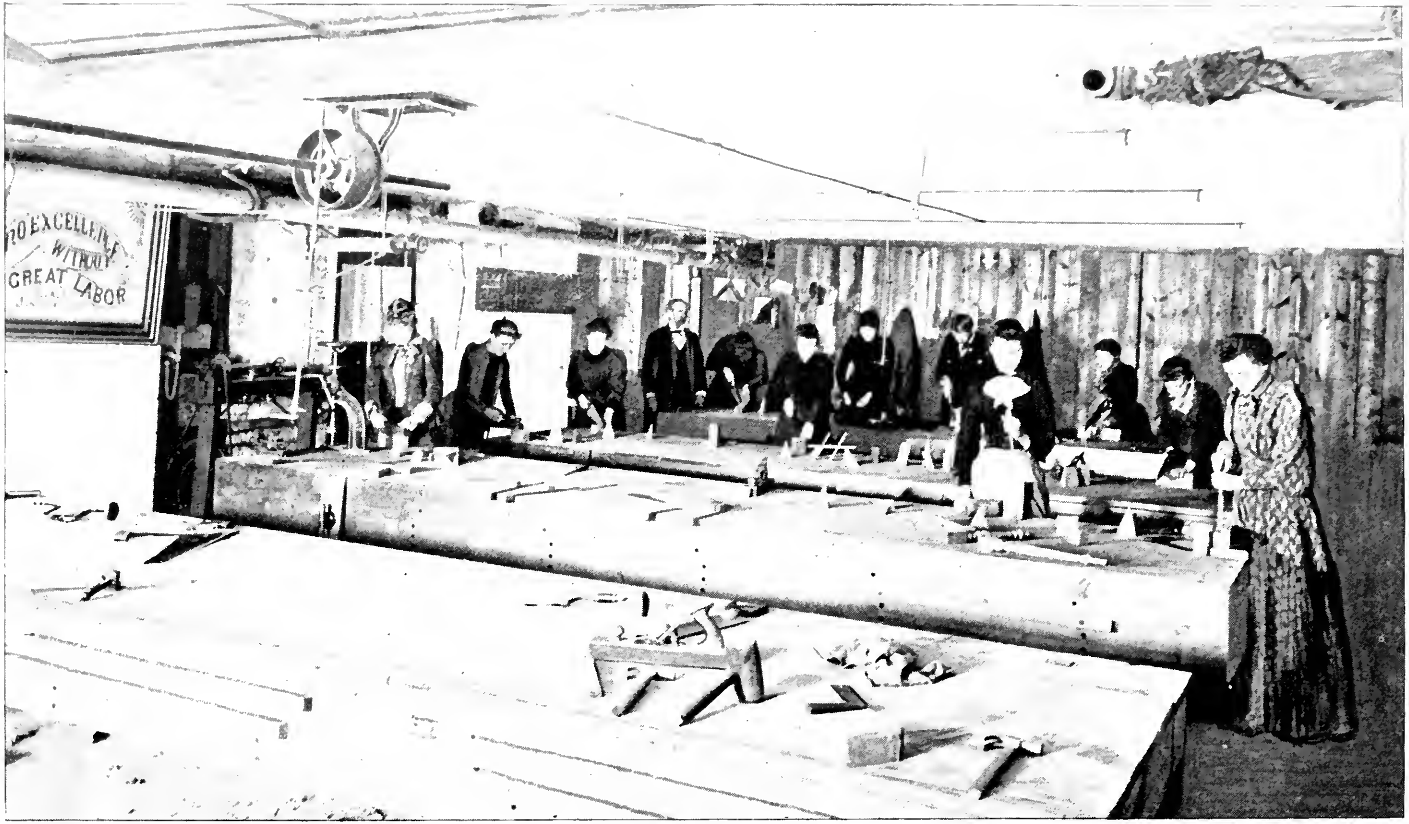
From the observatory, which crowns the central front of the building, the students see, as a whole, the views which all day long they catch from the windows below—views which have no small part in their student life. Northward stretches Ontario with boundless limit, its shores extending right and left in winding curves, bold bluffs, lowland, field, and forest. Below and around is the city: to the east, sloping down to the river and rising beyond it; to the west, soon shading off into farm lands; to the south, rising in a steep slope on which stands the City Orphan Asylum, a sister institution, tracing its origin to the same source. Whether the water and land sleep under a June sky or are vexed by January storms, the eye need ask for no finer scene.

As the mother of normal schools and methods, the Oswego school presents its most interesting aspect. Normal schools have been organized on the Oswego plan and called Oswego graduates to introduce her methods—as city schools in Portland, Boston, New Haven, New York, Philadelphia, Cincinnati, Indianapolis, Detroit, Washington, D. C., and other cities of less note; and as State schools in all the New England States, in New York, New Jersey, Pennsylvania, Indiana, Illinois, Wisconsin, Iowa, Minnesota, Nebraska, Kansas, Missouri, Mississippi, and California.* This influence was felt first in New England and the Mississippi Valley and later in the South.

The graduates of the Oswego school number 1,703. Oswego graduates have taught in every State and Territory except Idaho and Nevada, in the District of Columbia, and in five foreign countries. Of the graduates who were born and reared in New York State over four hundred have been called away to teach in thirty-nine States, two Territories, the District of Columbia, Canada, Mexico, South America, Sandwich Islands, and Japan. New York State has complained that through Oswego she has educated teachers for the schools of other States; but could any but an unnatural mother fail to be proud to have her children worthy to be thus called away, and glad to have within her borders an institution whose graduates are sought for from the Atlantic to the Pacific, from Canada to the Argentine Republic, and the borders of Asia?

* See Circular of Information No. 8, 1891, Bureau of Education, Washington, D. C., and Historical Sketches of the State Normal and Training School at Oswego, N. Y.

CHEMICAL LABORATORY.




WORKSHOP.

The fundamental causes of this widespread influence were the educational unrest which filled the United States forty years ago, and the fact that through Mr. Sheldon's efforts the Oswego school offered a means of satisfying it. This unrest made a good soil for the new educational ideas; these new ideas were discussed by school men before New York State had a normal school; and the school at Albany was founded and began the teaching of educational theories before the Oswego school was even thought of. What Mr. Sheldon did was to focus all these floating ideas on actual practice, and work out a systematic and rational expression of these theories for the daily work of the schoolroom—to do what other men were dreaming about. Doubtless Mr. Sheldon had unusual genius for organizing and teaching, but these exercised under purely selfish motives would not have led to such results. School work as a business, pursued for salary alone, attains no more than it seeks. E. A. Sheldon with his ragged Oswego boys and girls in 1848, and Heinrich Pestalozzi with his destitute orphans at Stanz in 1799, teach the same lesson. Love, hope, and faith are the most potent forces in education as well as in religion. Through these forces the Oswego movement began; through these, its founder became and has remained a seeker for educational righteousness, ready to try all things and to hold fast the better; through these, he became receptive of good influences from all sources, and eagerly sought to impart them to others. An incident occurring in 1861 shows how Oswego's gospel was at first spread. An invitation was issued to leading educators of different States to come to Oswego to observe the methods. This invitation was cordially accepted, and after careful examination these observers made a favorable report, stating that "the system of object teaching is admirably adapted to cultivate the perceptive faculty of the child, to furnish him with clear conceptions and the power of expression, and thus to prepare him for the prosecution of the sciences or the pursuits of active life." They also expressed the opinion that this system "demands of the teacher varied knowledge and thorough culture; and that attempts to introduce it by those who do not clearly comprehend its principles, and who are not trained in its methods, can result only in failure," thus indorsing the necessity of training schools.

The system introduced at Oswego is commonly called Pestalozzian, because it was inspired so directly from that source, for the Home and Colonial was founded by disciples of Pestalozzi. The essentials of Pestalozzianism may be summed up as a new point of view; and, as resultants of this, a new conception of education, and methods appropriate for realizing it.* The old education takes

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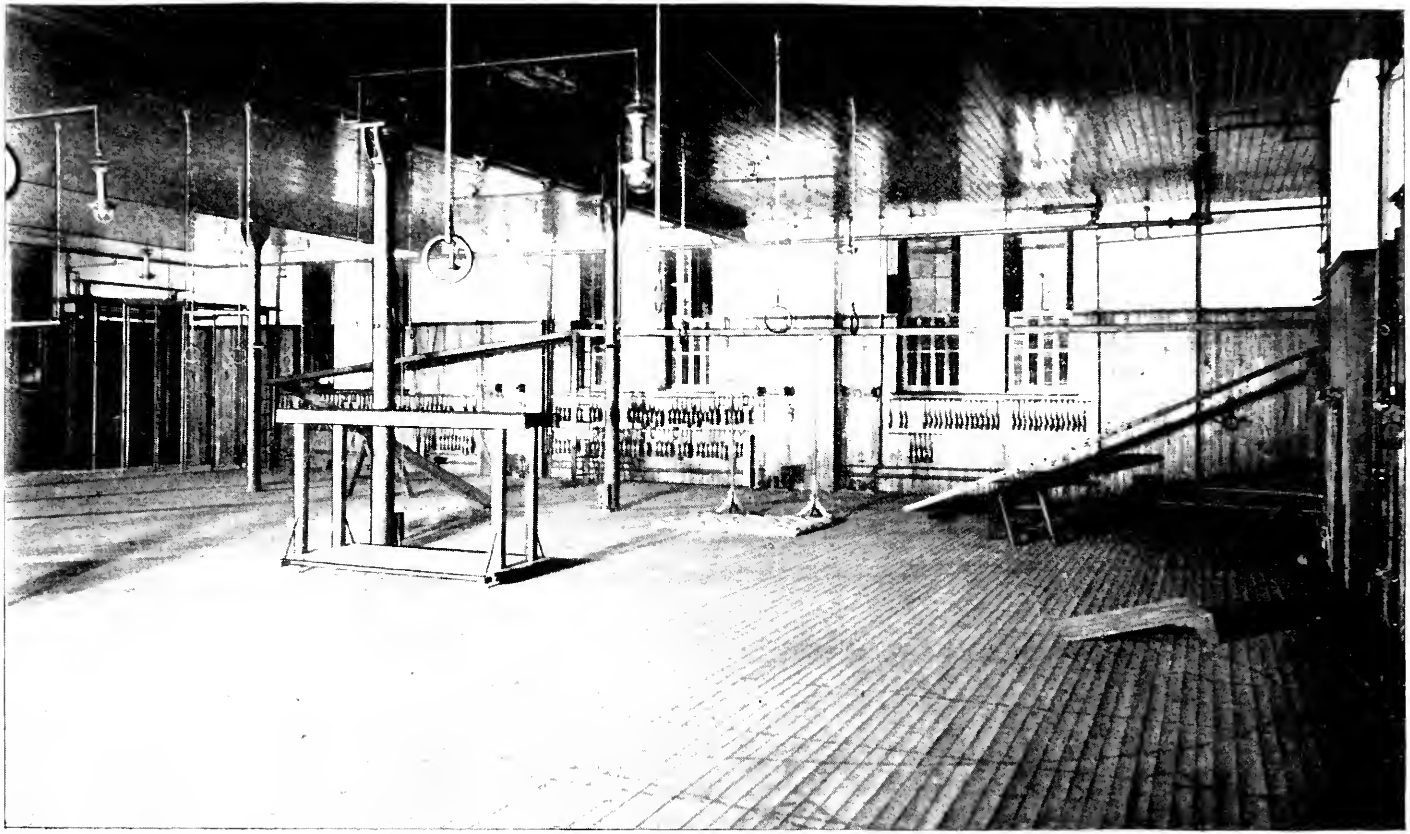
* See Krüsi's Life and Work of Pestalozzi.



GYMNASIUM.

the standpoint of the adult; the new, that of the child. From the former, the whole mass of heterogeneous facts composing the knowledge to be acquired is viewed as having been classified, labeled, and stored in books. From this conception, what method of acquiring knowledge can be more direct than the memorizing of books? By a cheerful optimism this system crams the child with words, and trusts that somehow he will grasp the ideas for himself and will have his powers cultivated in the process. In exceptional cases these objects are accomplished; but the average child is left in a condition of permanent mental dyspepsia and torpor. The new education conceives the child as looking forward into the phenomena of Nature and life, curious and eager to know realities first, then to express his knowledge, and delighted with the exercise of his powers. To bring the child into contact with facts, to guide him in classifying and labeling these facts for himself, becomes the teacher's first and chief duty, in obedience to the sound principle that development of powers is gained by their exercise only. From this point of view education is conceived of as a natural process extending from the cradle to the grave, with Nature as the chief teacher, and the mother as the first assistant, whose work is carried on by the schools and the experiences of life. In this natural process of education, ideas come before expressions, whether the idea be the child's first conception of color and form or the profoundest abstraction of a philosopher; and its principles are therefore applicable to education in all grades from the kindergarten to the university.*

As to the correctness of this conception of education and the general means of realizing it, there is substantial unanimity among school men; but, as to details of courses of study and methods of presenting subjects, diversity of opinion necessarily exists. Here, as in other fields, practice lags far behind theory. To the Oswego school belongs the honor of having developed in great detail courses of study and methods of teaching that have received the indorsement of educational reformers and of teachers in hundreds of schoolrooms as being capable of realizing in large measure the true educational ideal. Here also were devised simple and efficient means for giving teachers the training required for the new kind of work. To all who know how broad and how difficult to bridge is the chasm between educational theory and practice, these achievements will seem of no small importance. In this connection, Prof. Hermann Krüsi, for twenty-five years the teacher of the history and philosophy of education, geometry, French, and German; Miss Matilda S. Cooper, for the same period teacher

* For an interesting application, see Sheldon's General History, and Sheldon-Barnes's United States History, by Oswego graduates.

of English grammar and primary methods; and Prof. Isaac B. Poucher, from 1867 to the present time—excepting an absence of four years—teacher of arithmetic, algebra, and methods of teaching these subjects, should be especially remembered. In many a school called normal the pupils are, in preparatory instruction, taught exactly as they should not be, in defiance of the principles and methods to be mastered in their professional training. At Oswego the preparatory work in mathematics, language, history, natural science, etc., has, for the most part, been done by intelligent and loyal adherents of the school's professed principles, and been consistent with the methods inculcated in the professional work. The students having seen the daily application of these principles and methods to all sorts of subjects, and experienced their value in their own persons, more easily comprehend and apply them in subsequent method and practice work.

The Oswego movement did not lack opponents—a class whose services in all reforms are equally useful as extinguishers of false lights and disseminators of true. The most notable of these helpers was Dr. Wilbur, Superintendent of the New York State Idiot Asylum, a man eminently successful in his work. In the New York State Teachers' Convention of 1862, and in the National Convention of 1864, he severely attacked the whole system, from philosophical standpoints. In consequence, a committee was appointed to examine thoroughly the practical bearings of the "vicious" system. The chairman of this committee, Prof. Greene, of Brown University, visited the Oswego schools, tested their results thoroughly, and made his report before the National Convention of 1865. This report was so intelligent, exhaustive, and favorable that the underlying principles of the Oswego methods have never since met serious opposition in any authoritative body.*

Students at Oswego have sometimes complained of the rigorous drill of classes in methods, and of the practice school, as too mechanical, tending to produce mannerisms and to crush individuality. These complaints were sometimes made by those who best comprehended the principles and felt the power and desire to work out their own applications. These complaints admit this answer: For the average man and woman comprehension of principles does not secure practice. The principles must be embodied in precepts and rules, must be applied in a practical course of action under whose influence habits of right conduct are formed. Right habits can not be formed in the teacher by imparting to him the principles merely of his profession more than in the soldier. If in some cases the product of drill is a mere machine, it is

* See Circular of Information, No. 8, 1891, Bureau of Education, Washington, D. C.

usually because the person is inclined to become a machine, and a well-constructed machine is better than a poor one. The few so specially gifted as not to need so much detail and drill suffer no permanent injury by the temporary restraint of their powers of independent action. The habits formed in the thorough training school will but aid their steps into new paths in the wide field beyond its walls. To the careful, unremitting drill of her method and practice school work is largely due the fact that the Oswego Normal School has turned out so large a product of successful

HERMANN KRÜSI.

teachers as compared with her production of mere talkers and essay writers. No one else deserves so much credit for this as Miss Cooper. The maxims, The idea before the word, The concrete before the abstract, One step at a time, Never tell a child what he can find out for himself, were constantly applied by her as the plumb-line and try-square to test all work. Her method of inculcating principles and teaching the art of questioning was philosophical. The student was required to write out a series of logical questions and answers for drawing out the ideas to be taught; not once, but daily for twenty weeks, in a series of graduated lessons in each of the subjects to be taught in primary

schools. The imaginary child which each student set up for himself displayed his ignorance of child life; and his processes of questioning showed the limitations of his grasp of the principles involved. To the student whose sympathy with childhood is spontaneous and whose grasp of principles is intuitive, such drill is needlessly irksome. But that the vague notions of childhood and vaguer grasp of principles of most normal students can be developed and trained by such courses of drill only, the subsequent twenty weeks in the practice school will abundantly demonstrate.

The school has been exceptionally fortunate in its social and physical environments; and no enumeration of the causes of her

Matilda S. Cooper.

success can afford to omit these potent influences. The site of the city, at the mouth of the Oswego River and on the shores of Ontario, one of the fairest of our Great Lakes, is unsurpassed, both for beauty and for commercial and manufacturing advantages. Ridges which rise gently on both sides of the river near its mouth, and, farther back, form bold, picturesque hills, furnish almost ideal ground for a city. The place is not lacking in the charm of his-

toric associations. As one of the gateways to central New York, its old fort was the prize of battle between Indian, French, English, and Continentals during colonial and Revolutionary days. To one who has stood on the bluffs to the west of the old harbor, with the lake outspread as a shining mirror, and listened to the soft lapping of the waters on the shelving rocks below; or from the crumbling ramparts of the old fort on the eastern side has watched the sun like a burnished, golden shield slowly sink into the western waters, sending a flaming track across the wavelets, the soothing and restful influences were of unspeakable value. For a time the fret and fever of ignoble strife departed, and in the saner hour the spirit was open to better impulses. When the waters were lashed into fury by storms and hurled in fierce onset against the rocky shores, not less useful inspiration came from wind and wave—exultation in strength and courage for conflict. Nor did these influences altogether perish with the hour. What Oswego pupil, susceptible at all to Nature's influence, did not feel the power of those scenes and does not cherish their memory?

The social and religious influences of Oswego have been favorable to the Normal pupils. The city is not so large as to cause the Normal School factor to be ignored, nor so small as to cause it to have undue prominence. In churches, Sunday schools, and other societies pupils have been welcomed as guests and kept as valued helpers. A more important social influence has been the free mingling in work and recreations of the young men and women composing the school. In the recitation rooms and laboratories, this influence has produced wholesome rivalry and respect for one another's powers; at social gatherings and merrymakings, it has been refining and ennobling. For many a bashful boy and shy maiden, excursions on the lake and rambles in woods and fields have replaced awkwardness and constraint by the easy, natural manners of comradeship, and given insight into each other's natures and characters. Such introductions into the kingdoms of true manhood and womanhood are not the least among the school's gifts to her children. Social intercourse has always been left as free as the ordinary rules of propriety admit. Rarely has this freedom been misused, and the good arising from it has outweighed a thousandfold the evil. An important center of the school's social life is the Welland, the girl's boarding hall, whose parlors have so often echoed to the pleasures of the Friday evening socials.

Dr. Sheldon's home has been the chief center and source of social influences. This home is situated on a high, wooded point of the lake shore, a mile west of the city—a very paradise for quiet beauty. On the spacious grounds, beneath the shadow of

great forest trees, and in the hospitable halls of this home, many a generation of Normal pupils have had their merrymakings—springtime maple-sugar parties and autumnal fruit festivals and corn-roasts—the hearty participation of the master and mistress of the place making all feel at home. This home—with its evidence that refinement and simple but generous hospitality can be

Isaac B. Poucher.

maintained without wealth or extravagance; that gentle, winning manners and a cheerful heart are not incompatible with serious character and heavy burdens—has been the finest object lesson at Oswego.

Thirty years have passed since the tender shoot was planted that has grown into this stately tree: its fruits have dropped all over our land; some of the seeds have fallen on stony ground and withered away after a superficial growth; others have been choked by the growth of purely selfish ambitions and brought forth little fruit; but some have fallen on good soil and brought forth an hundredfold. Much has been done for education in our land during these thirty years, but a thousandfold more remains to be done to make the public schools what they must become to merit confi-

dence as the efficient conservators of our national happiness and prosperity. In the work of the past, the Oswego Normal has played an honorable part; but her mission is not yet ended, nor her powers abated. With youthful energy, both at home and through her graduates,* she is grappling with the question of *what* to teach, a question of not less importance than the *how*. That more useful and interesting material for study may be brought into schoolrooms, especially in the primary, is to be ardently desired. The best methods applied to trite or useless subject matter can not make school life interesting or valuable to pupil or teacher.

After all that has been done, and well done, no one but a most willful optimist can be blind to the lamentable defects of our schools.† The censure for these defects usually falls upon teachers, but does not primarily belong there. *Teaching* requires insight into and sympathy with child life, a condition spontaneous in but few adults, requiring in most laborious and sustained effort to gain and to maintain it; and a constant effort to advance in scholastic and professional attainments to escape slipping back into the abyss of slothful indifference. *Teaching* is, of all the professions, the most useful for the public welfare, as it is one of the most laborious and skilled, and should be paid according to its deserts. *Recitation-hearing*, however, is one of the easiest, least skilled, and most useless of all occupations. In this field, as in others, the public gets the kind of work it pays for. The wages of the rank and file of public-school teachers average less than those of skilled mechanics. As long as the public continues to pay for *recitation-hearing*, it will not get much *teaching;* for educational missionaries to work without the ordinary inducements are too few to supply the demand, and will probably continue so until the millennium.

There is need of educational statesmen to secure legislation efficient for preventing the employment of teachers without adequate scholastic acquirements and professional training, as physicians are forbidden to practice without such attainments. Is the body of so much more value than mind or soul that it should have greater safeguards? There is need of educational agitators to rouse and awaken the people from complacent day-dreaming about the schools, to show them that much of their expenditure is wasted through poor work, and to convince them

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* See work of Mr. L. H. Jones for Indianapolis schools in the Forum for December, 1892; "An Experiment in Education," in Popular Science Monthly for January and February, 1892; and the work of Prof. Barnes in Stanford University.

† See articles by Dr. J. M. Rice in the Forum for October, November, and December, 1892.

that better pay and more honor for their teachers would be a wise economy.

That our alma mater may bear as brave and glorious a part in the struggles of coming years as in the past must be the heartfelt wish of every graduate of the Oswego Normal and Training School.

## DECAY IN THE APPLE BARREL.

By BYRON D. HALSTED, Sc. D.,
RUTGERS COLLEGE.

FRUITS decay and everybody knows it, but how this rotting takes place is less evident. Grandfathers told our parents that it was due to the weather, and some of them may have held to the notion that the moon had a remarkable influence upon the keeping quality of various fruits. The perfection of the microscope and its more general use as an aid in seeing the minute things which surround us upon every side have led to a deeper comprehension of decays. It is the purpose of this article to show, if possible, some of the facts connected with the rotting of our apples, realizing that what holds true concerning one kind of fruit applies almost equally well to others.

Let us in the first place take a survey of the normal subject, or, in other words, of a healthy apple. It is made up of five seed cavities which occupy the central portion of the fruit and constitute the core. Outside of this is the edible portion called the flesh, consisting of cells of small size filled with liquid substances. A tough layer covers the outside, which is the skin, and bears the coloring substance that determines whether the apple is green, red, mottled, or striped. At one end of the fruit is the stem, or, as found in the barrel, this former means of attachment to the branch of the tree may have been broken away or pulled from the fruit—a matter of no small consideration when the question of decay is concerned. This end of the apple is known to the horticulturists as the "cavity," and varies greatly in different sorts, sometimes being deep and narrow as in the Winesap and Pearmain, and broad and shallow in the Greening and Peck's Pleasant.

The opposite end of the apple bears the name of "basin," and contains the remnants of the blossom—sometimes called the eye of the fruit. This part of the apple is likewise deep in some varieties, and shallow and open in others. This is the weakest point in the whole apple as concerns the question of the keeping quality of the fruit. If the basin is shallow and the canal to the core firmly closed, there is much less likelihood of the fruit decay-

ing than when it is deep, and the evident opening connects the center of the fruit with the surface.

For its own protection the perfect apple has a continuous layer of skin over its whole surface. The stem has not been removed from its cavity, but remains of its full length, for there is a place naturally provided for its separation from the branch which bore it. Such an apple is the rare exception as found in the barrel. At the market or in the storeroom of the consumer, instead of being without blemish upon the surface, there are small specks as large as a pin-head, or smaller, which dot the skin in patches. A portion of the surface of an apple with these specks is shown three times magnified in Fig. 1. Sometimes one needs to look for a long time to find a fruit entirely free from these specks. Under the compound microscope these dots are resolved into a thin layer of interwoven threads, with their free ends radiating from a central point. This is one of the low forms of plant life belonging to the molds, and grows from microscopic cells called spores, which in the economy of the mold serves the purpose of seeds. These spores are produced in great abundance, and, being carried by the air, alight upon the fruit and there germinate and grow into a colony or speck which is all the time feeding upon the substance obtained from the skin of the apple.

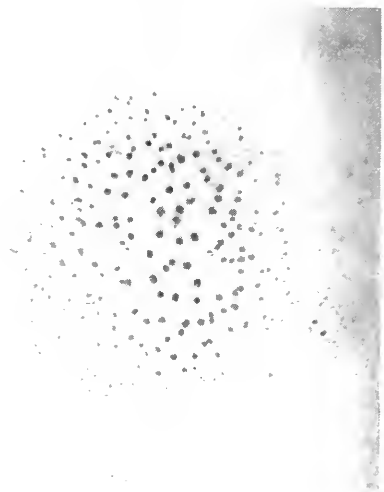

FIG. 1.—APPLE SPECKS. (Magnified.)

The second defect in apples, as seen in the barrel, is the one known to fruit-dealers as the "scab." To the eye this is recognized by the rough-coated patches, often circular in outline, that are present upon the skin. There may be several of these spots, and, by their borders becoming confluent, one half or less of a fruit may be thus rough coated and more or less dwarfed, making the apple one-sided. This scab is due to a mold which, under the microscope, is as different in its real structure from the specks above mentioned as the two are unlike in general appearance. If it will add anything to the value of this popular article, the botanical name of the species of mold causing the apple scab may be given as *Fusicladium dendriticum*, Fl. It is as much a distinct

kind of plant as the apple tree upon which it thrives. It is not confined to the fruit, but grows luxuriantly upon the foliage, causing it to become blotched with the brown patches and otherwise destroyed. The mold consists of fine, cobwebby threads, which penetrate the leaf and rob it of nourishment, and after a time form patches upon the surfaces, where innumerable spores of a dark color are produced.

The apples are first attacked by the scab fungus when they are quite small, probably while the tree is in blossom, or shortly after. At that time the surface of the young fruit is tender and has no well-developed skin, which, when the fruit nears maturity, might be so tough as to prevent the entrance of the scab mold. This, therefore, is a defect that does not come upon the fruit after harvest, and usually does not spread much after the apples are in the barrel.

The knowledge of the fact that the scab is due to a mold that begins to infest the fruit in early summer has led to experiments

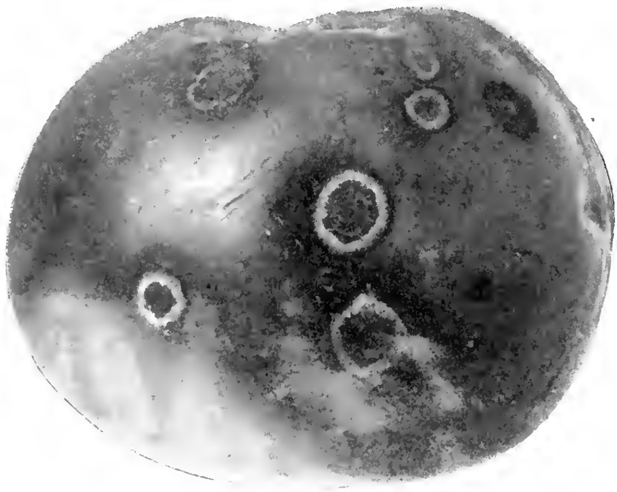

Fig. 2.—Apple Scab.

in spraying the trees during the growing season with the Bordeaux mixture and other fungicides, with marked success in checking its ravages. Trees sprayed three or four times in May or June have borne abundant fruit comparatively free from scab, while unsprayed trees otherwise alike yielded a scant amount of distorted, scabby, withered apples. Fig. 2 shows an apple that is a fair illustration of the working of the scab fungus.

One of the most interesting things in connection with the study of the decays of apples is the relation which one mold bears to another. There are several very common kinds of molds,

which grow nearly everywhere when circumstances favor them. Their spores seem to be almost omnipresent, but they do not possess the ability to penetrate tough substances, and the natural skin of the apple is usually a barrier they can not pass. Of all these molds the *Penicillium glaucum*, Lk., or commonly known as the "blue mold," is the one that causes the greatest destruction in the storeroom. A large part of the rapid soft rot is due to the *Penicillium*.

In a few words let the work of the scab fungus be reviewed. As the name indicates, it causes a scab upon the surface, the

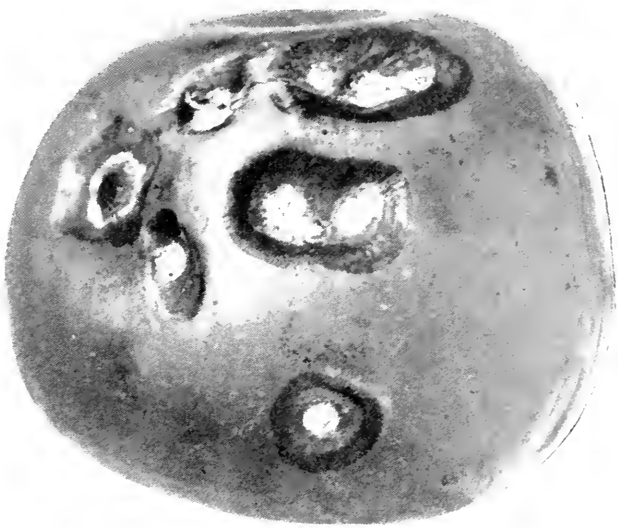

FIG. 3.—APPLE MOLD FOLLOWING APPLE SCAB.

naturally smooth, tough skin is roughened, and minute cracks are produced which in short replace the ordinary skin, impervious to the blue mold, with a disrupted coat that furnishes both a fine lodgment for the spores of the mold and the condition favorable for their germination and the further rapid growth of the mold. It is easy to conceive of the scab upon an apple being so slight and superficial as not to affect its real value, but the one defacement becomes the entrance of a decay germ, that in a few days reduces the whole apple to a noisome mass of rottenness resulting in a million spores or blue mold. To prevent the soft rot of the apple in midwinter in the barrel, the trees need to be sprayed in midsummer in the orchard, to check the development of the scab that would otherwise furnish the place of entrance of the blue mold. Fig. 3 shows an apple that, when harvested, had a number of rough circular patches due to the scab fungus. When the photograph was taken, each one of these spots was the seat of a

rapid decay, due to the development upon them of the *Penicillium*, while all other portions of the fruit were in a normal condition.

There are many diseases due to those exceedingly minute germs so widely talked of nowadays—namely, the bacteria. They attack animals and induce fevers of many sorts, and man sinks before them with the dreaded cholera, consumption, etc. Plants have their enemies among these micro-organisms, and apples do not enjoy an immunity from them. The succulent substance of a ripe apple is a favorite food for the bacteria, the only check upon their abundant entrance being the tough skin. But there are too many weak places, and it is presumable that these germs when falling upon them are capable of beginning their course of rapid multiplication which, when unchecked, reduces the fruit to rottenness. In Fig. 4 is seen an apple under the apparently unbroken skin of which in several places were decaying spots with no signs of any other mischief-makers than the swarming millions of the micro-organisms. As soon as the skin becomes broken in any such places, the coarser decay germs enter and quickly the fruit is overrun with a motley vegetation of various molds.

Fig. 4.—Apple Blotch.

If we look further among the decaying fruits, it will not be long usually before an apple is found that does not agree with any of the descriptions given above. Perhaps it is healthy in all parts save one, and that has no scab present. The blue mold is

absent, the skin is unbroken except in a peculiar, almost regular manner. There is an evident central point where the fungus started, and, as it has spread, numerous pimples have formed just under the skin, and sometimes in eccentric circles. From these minute light-colored pimples spores ooze out and are ready to find their way to some other specimen. The affected portion of the apple has a bitter taste, and, on account of this, the term "bitter rot" has long been given to this form of decay. This

Fig. 5.—Apple Bitter Rot.

same fungus causes the rotting of the grapes, and, if all the facts were known, this *Glœosporium fructigenum*, Berk., might be definitely charged with a large percentage of the decay of other fruits. An apple badly affected with the bitter rot is shown in Fig. 5, but one regrets that many of the details are lost in the photo-engraving process by which the engraving was made.

This form of rot while it may be met with upon the tree or in the windfalls beneath it in late summer, is most abundant in the storeroom and is decidedly contagious—that is, an apple that is decaying with the bitter rot is able to communicate the decay to other fruits by means of the myriads of spores which are borne upon the surface of the ruptured pimples. These facts suggest the precaution of discarding any rotting fruits whenever found. There is little room for doubt that were the harvested fruits themselves sprayed with a fungicide, it would aid materially in preserving them. Thus, if a thin coating of the Bordeaux mixture was applied, the spores of bitter rot and other decay germs would not so readily germinate. But there is the

objection of having the beauty of clean fruit lost under a film of fungicide that while not particularly poisonous is decidedly unpalatable, consisting of lime and sulphate of copper. A sensation was created in New York two years ago because grapes were thus marketed, and the same process for stored fruit is not here recommended, although its effectiveness as a preservative is granted.

A decay that might be mistaken for the last mentioned is caused by a fungus of a widely separated order. It is shown in Fig. 6. This might be called the black rot, as it has a strong tendency to turn the affected portions of a dark color. One of the characteristic features is the almost black pimples formed in considerable numbers beneath the skin, which they finally rupture and then discharge large numbers of dark-olive spores. This fungus is a described species bearing the name *Sphæropsis malorum*, Pk. It may be seen in early apples before they begin to ripen, and the windfalls as they lie upon the ground become badly infested with the *Sphæropsis*. It is not confined to the apple, but thrives destructively upon quinces and pears as well. This decay in its habits of growth calls to mind the fact that the basin is the weakest point of fruits like the three above mentioned, for in most instances the black rot begins at the free end where the remnants of the flower may be still adhering, and very likely assist in the fungus gaining a foothold. This decay, like the bitter rot, is amenable to treatment, and therefore, in order to check their destructive work in the storeroom, the fungicide needs to

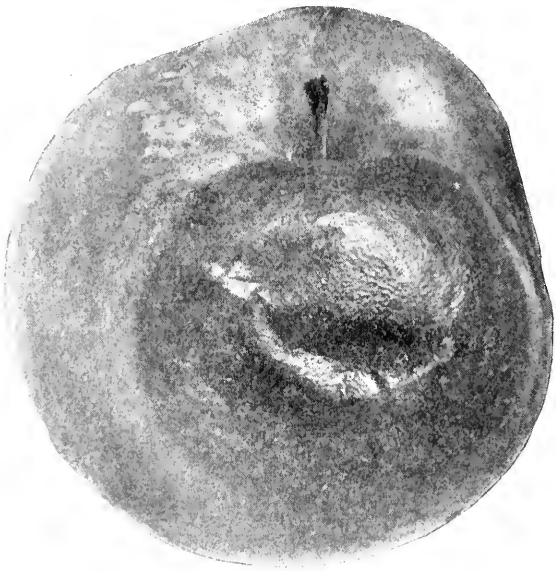

Fig. 6.—Apple Black Rot.

be applied while the fruits are growing upon the trees. Thus the work of the prevention begins a long time previous to picking—while the barrel-staves are possibly still in the living forest tree. This reminds one of the time when the boy's education should begin as stated by Dr. Holmes, namely, with his grandfather when he was a small lad.

Up to this point remarks concerning the mechanical treatment of apples have been purposely withheld. There is no question about the importance of so far as possible preventing the bruising of the fruit. From what has been said in strong terms concerning the barrier of a tough skin which Nature has placed upon the apples, it goes without saying that this defense should not be ruthlessly broken down. It may be safely assumed that germs of decay are lurking almost everywhere, ready to come in contact with any substances. A bruise or cut in the skin is therefore even worse than a rough place caused by a scab fungus as a lodgment provided by the minute spores of various sorts. If the juice exudes, it at once furnishes the choicest of conditions for molds to grow. An apple bruised is a fruit for the decay of which germs are specially invited, and when such a specimen is placed in the midst of other fruit it soon becomes a point of infection for its neighbors on all sides. Seldom is a fully rotten apple found in a bin without several others near by it being more or less affected. A rotten apple is not its brother's keeper.

The surrounding conditions favor or retard the growth of the decay fungi. If the temperature is near freezing they are comparatively inactive, but when the room is warm and moist the fruit can not be expected to keep well. Cold storage naturally checks the decay. The ideal apple has no fungous defacements and no bruises. If it could be placed in a dry, cool room free from fungous germs it ought to keep indefinitely until chemical change ruins it as an article of food. But the facts in the case are far different from this ideal. The apple when gathered from the tree may have the germs of decay already within its tissue. They may have extended through the basin, become firmly located in the ragged remnants of the flower or by means of some insect or "worm" that has bit or burrowed the fruit. Its stem may have been broken close to the fruit or pulled out from it, or over the surface specks and scabs may have formed during the season of growth that have so destroyed the skin as to furnish a ready entrance for other more destructive germs. Bruises of the pulp and breaks in the skin expose the soft, highly decomposable flesh to the "seeds" of decay, and as one contemplates what an apple is made of and its many enemies, it seems almost a marvel that fruit keeps at all until it is cooked to kill the germs within it and then canned to prevent the entrance of those that are without. It

is not designed that apples in their natural state should keep for long, and all attempts to preserve them in the fresh condition through the winter and far into the succeeding spring are a triumph against Nature only to be won by the person who is conversant with the methods of his microscopic opponents. The use of fungicides in the orchard while the fruit is growing will insure more and fairer specimens, thus filling a larger number of barrels with apples that are less subject to attack after harvest. This, with careful handling to avoid bruises when picked and housed, together with a dry storage room, should all bring a full reward. Fig. 7 shows an apple in the last stages of dissolution, overrun inside and out with a diminutive forest of fungi. It is the seed-

Fig. 7.—Apple Mold.

time, so to speak, with the host of species each vying with the others for the last particle of the apple, the seeds only being left behind ready to grow into trees when suitable circumstances obtain, provided the vital spark does not expire before the favoring condition arrive. The pulp that has been destroyed is largely man's product developed by him through long years of selection and culture, and for which the orchard is planted and preserved. Nature wants more apple seed; man desires more and better pulp. Nature claims that the pulp of the wild apple is only to secure the wider dissemination of the seed, and to the orchardist, middleman, and consumer she speaks in her emphatic way that "if you would exact of me extra-fine pulp, you must at the same time employ the best devices of your high civilization to preserve it from your omnipresent and active competitors, the insidious germs of decay."

# THE DISCOVERY OF ALCOHOL AND DISTILLATION.

By M. P. E. M. BERTHELOT.

ALCOHOL is an important factor in modern civilizations, the source of great revenues to states, and of immense wealth to those who deal in products containing it. While wine, beer, hydromel, etc., have been in use from prehistoric times, the active principle common to them which produces the pleasant excitement and the disgusting intoxication, and which is concentrated in spirituous liquors, alcohol, has been known for only seven or eight centuries; it was unknown in antiquity. The story of the way the discovery of it was made is one of much interest.

The reservation of the name of *alcohol* for the product of the distillation of wine is modern. Till the end of the eighteenth century the word, of Arabic origin, signified any principle attenuated by extreme pulverization or by sublimation. It was applied, for example, to the powder of sulphuret of antimony (*koheul*), which was used for blackening the eyes, and to various other substances, as well as to spirits of wine. No author has been found of the thirteenth century, or even of the fourteenth century and later, who applied the word alcohol to the product of the distillation of wine. The term *spirit of wine* or *ardent spirit*, although more ancient, was also not in use in the thirteenth century; for the word spirit was at that time reserved for volatile agents, like mercury, sulphur, the sulphurets of arsenic, and sal ammoniac, which were capable of acting on metals and modifying their color and properties. The term *eau-de-vie* was given in the thirteenth and fourteenth centuries to the elixir of long life. It was Arnaud de Villeneuve who employed it for the first time to designate the product of the distillation of wine. But he used it, not as a specific name, but in order to mark the assimilation which he made of it with the product drawn from wine. The elixir of long life of the ancient alchemists had nothing in common with our alcohol. Confusion of the two has led the historians of science into more than one error.

Our alcohol first appeared under the name of inflammable water, a name which was likewise given to spirits of turpentine. Let us try to determine, from the ancient authors and those of the middle ages, what was the origin of the discovery of alcohol, and to trace the successive steps in the knowledge of that substance. The ancients observed that wine gave out something inflammable. We read in Aristotle's *Meteorologica*, "Ordinary wine possesses a kind of exhalation, and that is why it gives out a flame." Theophrastus, an immediate disciple of Aristotle's, says, "Wine poured upon the fire, as for libations, throws out a light"

—that is, produces a shining flame. Pliny says, still more decidedly, that the Falernian wine, the product of the Faustian field, is the only wine that can be ignited "on contact with a flame"; a thing that happens with some wines very rich in alcohol. These are common phenomena, accidental observations made in the course of sacrifices and festivals which served as the beginning of the discovery. But there had to be many intermediate steps. Among them was this experiment, an amusing trick in physics, doubtless devised by some prestidigitator, which is explained in a Latin manuscript in the Royal Library of Munich: "Wine can be burned in a pot, as follows: Put white or red wine in a pot, the top of the pot being raised and having a cover with a hole in the middle. Having heated the wine till it begins to boil and the vapor comes out through the hole, put a light to it. The vapor will at once take fire and the flame will last as long as it comes out." But alcohol was not isolated by the ancients.

Distillation, or a method of separating the inflammable principle from wine, had to be discovered before a further knowledge of alcohol could be gained. This process passed through several stages. It also started from common observations. When water is heated in a vessel, its vapor condenses on the walls of surrounding objects, and especially on the cover of the vessel; this can be observed by every one, in domestic economy, on the covers of soup dishes, of kettles, and of tea and coffee pots. Aristotle mentions the fact in his *Meteorologica*. "Vapor," he says, "condenses under the form of water, if we take pains to collect it." He speaks in another place of a less usual observation, which was probably likewise accidental, and which has been extensively applied in our own time. "Experiment has taught us that sea-water when converted into vapor becomes potable, and the vaporized product, when condensed, no longer resembles sea-water. . . . Wine and all liquids, when vaporized, turn into water." It appeared, then, according to Aristotle, as if evaporation changed the nature of the vaporized liquids and reduced them all to an identical condition—that of water. This change was conformable to the philosophical ideas of the author, wine and sea-water being reduced to the same condition of water, the principle of liquidity, which was regarded by the ancient philosophers as one of the four fundamental elements of things.

Aristotle's remarks on sea-water soon gave the suggestion of a practical process mentioned by Alexander of Aphrodisias, one of his earliest commentators, about the second or third century A. D. According to that author, sea-water was heated in brass kettles, and the water that condensed on the covers was collected for drinking. This was the germ of the industry of the distillation of sea-water, which is practiced now on a large scale on board of ves-

sels. But, before this process could be carried out in a practical form, the modern improvements in the process of distillation had to be discovered.

Similar processes to that mentioned by Alexander of Aphrodisias are described by Dioscorides and Pliny, in the first century A. D., for the preparation of two liquids so different as mercury and spirits of turpentine. These discoveries, also met in accidental observations, began to make more general the ideas of the industrial men and physicists of the time. Cinnabar, or sulphuret of mercury, has been used from remote antiquity as a red coloring matter (vermilion); the Romans got it from Spain, where the principal mines of mercury in Europe are still situated. It was early remarked that, in heating in an iron vessel to purify it, it disengages vapors of mercury, which are condensed on neighboring objects, chiefly on the cover of the vessel. This discovery was the origin of the regular extracting process, described by Dioscorides and Pliny. The cinnabar was placed in a capsule of iron in the middle of an earthenware pot. The cover was sealed on, and heat was applied. After the operation the cover was scraped, in order to detach and collect the globules of mercury which had sublimed from the capsule. Thus was obtained artificial quicksilver, which the ancients supposed to have different properties from natural quicksilver, or that which occurs in Nature in mines. This was an illusion, the mercury being identical, whatever the mode of extraction. At any rate, the process employed for the extraction of mercury by vaporization is the same as that described by Alexander of Aphrodisias for making sea-water potable; and this process, as I shall shortly explain, was the beginning of the alembic.

Another rudimentary process, the first that was applied to the extraction of an essential oil, is described by Dioscorides and by Pliny. It is for the distillation of pine resins, which are now called turpentines. They were heated in vessels over which wool was spread; this condensed the vapor; then the wool was pressed, in order to extract from it the liquefied product, spirits of turpentine, which was then called resin oil or flower of resin. It soon assumed an important function in the composition of the inflammable substances used in the arts and in war. But these terms seem at first to have designated also and at the same time the most liquid part of the resins, as well as the water charged with their soluble principles, which was floating on these resins like whey on milk, at the moment of their extraction; and, lastly, the distilled and odorous water which was vaporized at the same time with the essence. The ancients were in some confusion about these substances, which are distinct in modern chemistry; and this it is which makes the reading and interpretation of the old authors so hard.

The decisive step in the knowledge of distillation was taken in Egypt. There were invented the first real distilling apparatus during the first centuries of the Christian era. They are described precisely in the works of Zosimus, an author of the third century, from the technical treatises of two women chemists named Cleopatra and Mary. In the margin of a Greek text of St. Mark are the drawings of the apparatus, and they agree exactly with the author's descriptions. The apparatus consists of a boiler or balloon-shaped receiver, in which the liquid was put; but the cover was replaced by a large tube topping the balloon, and ending above in a cap shaped like an inverted balloon, to serve as a condenser. The cap was furnished with lateral conical tubes inclined downward, which were intended to collect the condensed liquid and allow it to flow out into small bottles. All the essential parts of a distilling apparatus are here defined. These lateral tubes and their recipients constitute the chief improvement, and are what constitutes the alembic. Among the distinctive characteristics of the primitive alembic described by Zosimus is the multiplicity of the abductor tubes. He distinguishes between two-beaked and three-beaked alembics. The flow of vapor was simultaneous, though there were several beaks, and condensation took place in two or three receivers at once. Another figure represents an alembic with a single beak, to which a large copper tube was attached. An alembic described by Synesius, an author of the fourth century, and figured in less ancient manuscripts, shows the boiler with its cap, furnished with a single tube, the whole apparatus being heated in a marine bath. This form varied but little till the sixteenth century. The alembic passed from the Greco-Egyptian experimenters to the Arabs without any notable change. The Arabs were not, therefore, the inventors of distillation, as has been too often affirmed. In chemistry, as in astronomy and medicine, they merely reproduced the apparatus and processes of the Greeks, their masters, adding a few improvements in details. It is a mistake to trace the discovery of distillation and of alcohol to Rases, or Abulcasis, or other Arabian authors; the verified texts have at least furnished me no indication of that kind. In fact, Rases (tenth century), in the passages cited in support of that opinion, speaks only of vinous liquids or false wines obtained by the fermentation of sugar, honey, and rice; liquids, some of which, like hydromel, were known to the ancients. But there is nothing about distilling them, or extracting a more active principle, in any passage in Rases that I am acquainted with. In the pharmaceutical works attributed to Abulcasis or Abulcasim, a Spanish doctor of Cordova, who died in 1107, we only find a distilling apparatus for preparing rose-water which did not differ in principle from those of the old Grecian alche-

mists. The Arabs, therefore, were still, in the beginning of the fourteenth century, using the complicated apparatus of the Greco-Egyptians.

Alembics with several beaks were still employed by the Western alchemists in the sixteenth century. In Porta's treatise, entitled Natural Magic, a collection of processes or secret operations, the author mentions the cap of three and four beaks, each furnished with its tube and receiver. It is still the old apparatus of Zosimus. Porta, however, describes two important improvements which have come down to modern industry—graduated condensations during the same operation and the cooling worm. We need not suppose that he invented them, but only that he described the practice of his time. The new feature is as follows: In the alembics described by Zosimus the three pipes are at the same level, and doubtless disengaged an identical vapor; the ideas of the chemists of the time were too vague to allow anything else to be expected. The three tubes of Porta, on the other hand, are at different heights, and the author adds that the highest tube furnishes the purest spirit. We can already discern the ideas that have fructified in our apparatus for fractional rectification, with series of superposed chambers and trays delivering alcohols of higher degrees of concentration from the higher levels. This arrangement, however, was abandoned; at least we find no more trace of it during the following centuries. In this as in many other incidents, the men of the sixteenth century foresaw the most modern advances, but by a kind of intuition, without their having those clear notions and those exact principles of physics which, being wanting, progress is accidental and transient.

Another more durable improvement was that of the worm. The alembics of the ancient Greeks doubtless permitted distilled liquors to be obtained, but on condition of operating slowly and with a very moderate heat. In fact, the vapors were imperfectly condensed on the small surfaces of the tubes and the caps represented in the manuscripts. However little we might try to hasten the distillation, the receivers would become warm and condensation would become almost impossible. Hence the ancient authors prescribed that their apparatus should be heated over very slow fires. They operated by means of sand baths, baths of ashes, or water baths. Sometimes they tried to distill with no other heat than that of fermenting manure or a low fire of dung or sawdust. Their operations were therefore very slow, and often lasted for days and weeks. It required fourteen days, or twenty-one days, a text would say, to perform the operation. Not only did they in this way assure the effect of digestions and cementations, designed to produce gradual permeation with sulphurous and arsenical vapors, into sheets of metal submitted to the tinctorial action of

the elixirs, but they also made it practicable to collect the liquids placed in the alembics.

At last, however, the operators of the middle ages perceived that the manipulations could be conducted more rapidly, the distillations, for instance, by cooling the cap and the connected tube that conducted to the last receiver. For that purpose they first fixed around the boiler cap a bucket filled with cold water; this facilitated the condensation, but caused a part of the liquefied vapors to fall back into the boiler. A new improvement—the one described by Porta—consisted in bending the tube between the cap and the receiver and giving it the form of a serpent. This was the origin of the modern still-worm. It was surrounded by cold water in a wooden vessel. But the use of the serpentine arrangement spread very slowly, and was still regarded as recent by the authors of the eighteenth century.

Let us observe here that we are using the word distillation in the modern sense of evaporation followed by a condensation of liquid; but in many authors of the middle ages the sense is more vague. The word means, in its literal sense, a flow drop by drop, and is applied equally to filtration and all refining and purification. The word distill is often employed in the same sense in modern language. It also comprehended from the Greco-Egyptian epoch two fundamentally distinct operations, viz., the condensation of dry vapors into a solid form—such as calamines or metallic oxides, sulphur, metallic sulphurets, arsenious acid and metallic arsenic (which was the second mercury of the Grecian alchemists), and at a later date chlorides of mercury, sal ammoniac, etc.—the process which is now called sublimation. It requires special apparatus, which the ancients devised and used, and which gave rise to the Arabian aludel. We mention this here on account of its connection with many modern industries, although it has no relation to the discovery of alcohol.

I proceed now to describe distilled liquids and the successive steps made in their study. "Celestial things above, terrestrial things below," was the phrase by which the Grecian alchemists designated the products of all distillation and sublimation. They declared that "the sublimed vapor emitted from below up is called divine. . . . White mercury is likewise called divine, because it, too, is emitted from below up. . . . The drops which affix themselves to the covers of boilers are likewise called divine." In this expression we find the marks of Aristotle, Dioscorides, and Alexander of Aphrodisias. The alchemists, according to their usage, interpreted these purely physical ideas by symbols and a curious mysticism. Democritus (or the alchemic author who took that name) called the spherical apparatus in which the distillation of water was carried on "celestial natures."

The separation which is effected in these between volatile water and fixed matter is expressed as follows in the text of Olympiodorus, who lived at the beginning of the fifth century: "Earth is taken in the early morning, still impregnated with the dew which the rising sun lifts with its rays. It is then like a widow and deprived of its spouse, according to the oracles of Apollo. . . . By divine water I mean my dew, aërial water." In the same style Comarius, a writer of the seventh century, drew the allegorical picture of evaporation and the condensation that accompanies it, condensed liquids reacting on the solid products exposed to their action: "Tell us . . . how the blessed waters descend from above to visit the dead, stretched out, chained, and loaded down in darkness and shadow, in the interior of hades; . . . how new waters enter in, . . . come by the action of the fire; the cloud holds them up; it rises from the sea, sustaining the waters."

This singular language, this enthusiasm borrowing the most exalted religious formulas, need not surprise us. The men of that time, excepting a few superior geniuses, had not reached that state of calm and abstraction that permits the contemplation of scientific verities with a serene coolness. Their education, the symbolical traditions of ancient Egypt, and the gnostic ideas with which the first alchemists were all impregnated, did not allow them to preserve their even balance. They were transported and intoxicated, as it were, by the revelation of that hidden world of chemical transformations which appeared to the human mind for the first time.

In the first Greek treatises, all the active liquids of chemistry are confounded under the common name of divine water or waters. "Divine water is one in kind," they said; "but it is multiplied as to species, and admits of an infinite number of varieties and methods of treatment." They designated those varieties by the most various symbolical names, such as aërial water, fluvial water, dew, virginal milk, water of native sulphur, silver water, Attic honey, sea-foam, etc. Confusion was systematically engendered by this variety of denominations, for the avowed purpose of concealing the secrets of the alchemical fabrications from the vulgar and uninitiated. Although it is occasionally possible to discern something precise in the deliberate vagueness of the descriptions, there does not exist among them, so far as I know, any text that is applicable to the distillation of wine. It is barely possible that the principle of fractional distillation and the diversity of its successive products are indicated in one or two passages, but those passages appear to apply to the treatment of alkaline polysulphides or of organic sulphureted substances, which have nothing in common with alcohol.

I have not, moreover, met in the Arabic treatises on medicine

and *materia medica* as yet printed, or in the manuscript Arabic works of Geber and other alchemic authors which I possess and am preparing for publication, with any precise text relative to alcohol or to any definite distilled liquid. I have already explained the passages of Rases that have been wrongly cited as bearing on this point, which relate only to fermented liquids without reference to their distillation or to the extraction of alcohol. So Abulcasim, who has been cited, after describing some distilling apparatus modeled after the *dibicos* and *tribicos* of the Greeks, adds simply, "According to this method, whoever wants distilled wine can distill it." He gives directions for distilling rose-water and vinegar in the same way. He speaks only of distillation in a mass. Still, the idea of the preparation of a distilled fragrant water, like rose-water, appears here clearly for the first time; but there is nothing in it that applies to an essence proper, or especially to alcohol.

I repeat that simply a distillation of wine, without any distinction between the successive products of a fractional distillation, is meant in these texts. But it was perceived from that time, contrary to the opinion of Aristotle, that distilled wine was not identical with water; still, our authors do not speak of alcohol, although the knowledge of that substance would result almost immediately from the study of the distilled liquids yielded by wine.

The most ancient manuscript containing a precise reference to this product is in the *Clef de la peinture*, which was written in the twelfth century. It is a receipt in cipher, which when deciphered and translated reads: "By mixing pure and very strong wine with three parts of salt and heating it in vessels designed for the purpose, we obtain an inflammable water, which is consumed without burning the matter on which it is placed." This meant alcohol. The property of burning on the surface of bodies without burning them greatly struck the first observers of it. A more explicit mention is contained in the Treatise on Fires of Marcus Græcus, a Latin work drawn from Arabian and Grecian sources, no manuscripts of which, however, are of earlier date than the year 1500. It is a compilation of technical receipts, mostly relating to the art of war. The receipt for the burning water was added later to the original text; for it is not a part of another manuscript that exists in Munich, but is inserted in it outside of and after the Treatise on Fires. It contains some new hints and characteristics, and is as follows: "*Preparation of Inflammable Water.*—Take wine, black, thick, and old. For a quarter of a pound add two scruples of very finely powdered sulphur, one or two of tartar, extract of a good white wine, and two scruples of common salt in coarse fragments. Place the whole in a

good leaden alembic; put on the cap, and you will distill the burning water. It should be kept in a glass vessel tightly closed." The Munich manuscript adds: "These are the virtue and properties of the inflammable water: A rag moistened with it and set on fire will burn with a great flame. When the fire is extinguished the cloth will be found unharmed. If you dip your finger in this water and then put fire to it, it will burn like a candle and not suffer any wounding." This was in fact a prestidigitator's trick; and the part those people played is manifest in the beginnings of a large number of inventions in antiquity and the middle ages. In any case the facts pointed to in this description are exact, and show how first observers are often struck by real or apparent properties of bodies, even though they be insignificant. Frequently, too, they complicate operations by superfluous if not annoying details, to which, according to the theories by which they are guided, they attach the same importance as to the rest. For instance, in the first receipt of Marcus Græcus is a direction to add sulphur previous to the distillation, which occurs likewise in a book by Al Farabi, transcribed into another manuscript of the same period, as well as in Porta's Natural Magic, which was composed in the sixteenth century. It is therefore not accidental. It is the product of a theory which is expounded at length in several texts, held by the chemists of the time, that the great moisture of wine is opposed to its inflammability. To counteract this they added salts or sulphur, the dryness of which, they said, augmented the combustible properties. One of these old authors refers, in support of his theory, to dry wood and green wood, unequally combustible, according to the season when they were cut and the proportion of moisture they contain.

We should recollect also that volatility and combustibility were then confounded and called sulphurity, a term which was still applied in this sense in the time of Stahl, at the beginning of the eighteenth century. These ideas go back to the Grecian alchemists, who called every volatile liquid and every sublimate sulphurous (or divine) water. In this we can see the origin of those complicated preparations, so hard to understand now, which were employed by the old alchemists. They tried to communicate to bodies the qualities in which they were lacking by adding to them substances in which those qualities were supposed to be concentrated. Hence sulphur was added to wine in the belief that it would render the manifestation of its inflammable principle easier.

The first man of science known by name who spoke of alcohol is Arnaud de Villeneuve, who was of a date posterior to the composition of these writings. He is commonly spoken of as the author of the discovery, though he never himself presented such a claim. He only spoke of alcohol as a preparation known in his

time, which he admired very much. He recorded of it in his work Concerning the Preservation of Youth: "We extract, by distillation of wine or its lees, burning wine, called also *eau-de-vie*. It is the most subtile portion of the wine."

He then exalts its virtues: "*Discourse on Eau-de-vie.*—Some call it water of life; some of the moderns say it is permanent water, or rather golden water, on account of the sublime nature of its preparation. Its virtues are well known." He next enumerates the maladies for which it is a cure: "It prolongs life, and therefore deserves to be called water of life. It should be kept in a golden vessel; all other kinds of ware, except glass, are liable to be acted upon by it." Then he speaks of alcoholates: "On account of its simplicity, it receives every impression of taste, odor, and other properties. When the virtues of rosemary and sage are imparted to it, it exercises a favorable influence on the nerves," etc. The pretended Raymond Lulle, a more modern author than Arnaud de Villeneuve, speaks of alcohol with equal enthusiasm. He describes the distillation of the inflammable water, derived from wine, and of its rectifications, repeated seven times if necessary, till the product burns without leaving a trace of water, and adds, "It is called vegetable mercury." So it appears that the alchemists in the beginning of the fourteenth century were taken with such admiration for the discovery of alcohol that they likened it to the elixir of long life and the mercury of the philosophers. Yet we have to be cautious against taking every text concerning the mercury of the philosophers or the elixir of long life as applicable to alcohol.

The elixir of long life is a fancy of ancient Egypt. Diodorus Siculus calls it "the remedy of immortality." Its invention is attributed to Isis, and the composition of it may be found in the works of Galen. The formulas for it in the middle ages were various. It was also reputed to be capable of changing silver into gold, or, in other words, was credited with the same chimerical properties as the philosopher's stone.

Although the discovery of alcohol did not give realization to these illusions, it has nevertheless had the gravest consequences in the history of the world. Alcohol is an eminently active agent, and thereby at once useful and harmful. It may prolong human life or shorten its term, according to the use that is made of it. It is also a source of inexhaustible wealth for individuals and states—a more fruitful source than the pretended philosopher's stone of the alchemists could have been. Their long and patient labors were therefore not lost; and their dreams have been realized beyond their hopes by the discoveries of modern chemistry.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

# TRIBUTE OF THE FRENCH ACADEMY TO AMERICAN GEOLOGICAL EXPLORATION.*

THE following tribute to the Americans who have conducted meritorious geological and geographical explorations is a graceful and well-bestowed recognition from the French people of the remarkable results that have been achieved in this country by individual and Government agencies in adding to the sum of human knowledge. The tribute of words is even more beautiful than the elegant medal which accompanied it, and while the United States Geological Survey is made the official recipient of the gift, it will be seen that it is intended to honor other American workers in this field of science.

Institute of France, Academy of Science. Meeting of December 21, 1891. Pages 70 to 74.

## CUVIER PRIZES.

COMMISSIONERS: MM. GAUDRY, FOUQUÉ, DE QUATREFAGES, MILNE-EDWARDS.
M. DAUBRÉE, RAPPORTEUR.

The commission charged with awarding the Cuvier prize for the year 1891 has with unanimous voice given this high mark of esteem to the collective work of the Geological Survey of the United States.

In the United States, where all the natural resources are exploited with so much ardor, the studies relative to the soil ought necessarily to demand a very particular attention by reason of the numerous applications which they legitimately promise. It is therefore more than half a century since the governments of many States instituted a geological exploration of the lands which belonged to them. These geological surveys were organized and confided to men most prominent in their profession. It was in the Northern States that the most considerable progress was made. Hitchcock published, in 1833, the Geology of Massachusetts. From 1836 to 1840 the eminent Henry Rogers and his brother, W. B. Rogers, undertook that of Pennsylvania and Virginia, the essential characteristics and distorted structure of which they so admirably made known. Charles T. Jackson, of Boston, the discoverer of etherization, and already known by his mineralogical works, undertook that of Maine, New Hampshire, and Rhode Island (1837 to 1839), after having published in 1833 a study of Nova Scotia. The geology of the State of New York is confided to James Hall—who has not yet discontinued the series

* Translated by Robert T. Hill, of the United States Geological Survey.

of his discoveries—Mather, Emmons, and Vanuxem. It has given existence to publications that have become classic (1836 to 1842). By the side of these promoters who have the merit of having been the first to conquer the greatest difficulties, justice demands that there should be written the names of two geologists not attached officially to the service of the United States, whose powerful influence ought to be proclaimed. Our compatriot De Verneuil pursued since 1846, with the success that is well known, a task which no other could better undertake, that of comparing upon the two continents all the sedimentary deposits, from the most ancient down to those that contain the coal; and Dana, by his original work and by his excellent books, has contributed singularly to the education of all those who, in Europe as well as in America, devoted themselves and still devote themselves to the study of geology and mineralogy.

The first results attained proved the utility of like enterprises. Thus, following the steps of the local governments, the Federal Government entered into the same path.

It was at first for the great Territories of the West, little known and not yet classed as independent States. The wise geologist Hayden, to whom this study was confided and of whom we deplore the loss, worked there with ardor during a dozen years. First of all had to be adopted a rational plan for an exploration at the same time geographic and geologic. This new service bore, indeed, the title of Geological and Geographical Survey of the Territories. Then followed the discovery in 1871, and the detailed exploration in 1872, of the region of the geysers of the Yellowstone; from 1873 to 1879 the complete topographic and geologic survey of the Alpine part of the Rocky Mountains comprised in the State of Colorado. The atlas which unites all these researches (1877) is a *chef-d'œuvre* of cartography; it is in great part the work of Mr. Holmes, the artist-geologist, of whom one admires the incomparable sketches scattered in profusion through the official publications.

In order to explore the Rocky Mountains (1869 to 1875), Mr. J. W. Powell descended by water the celebrated and dangerous cañons of the Colorado, and made a report which has become classic on the phenomena of erosion. During the same epoch Mr. Gilbert made an extremely remarkable study of the Henry Mountains.

At the same time the Engineer Department of the United States Army was charged with work of the same class over an immense country still little more than desert and very little known. The title of this new service, "Geological and geographical exploration and survey of the one hundredth meridian," shows that, in this case also, the examination of the constitution of the

soil marched side by side with the study of its topography and relief. This important mission was placed, in 1872, under the direction of Lieutenant Wheeler, who in the preceding year had explored a portion of Nevada and Arizona. The choice could not have been better, as is proved by the career since then of the distinguished engineer. His purpose was to reconnoitre the natural resources of the mountainous country in the neighborhood of the chosen parallel, and also of the great railroad lines of the Union and Central Pacific between the one hundred and fourth and one hundred and twentieth degrees of longitude west from Greenwich. After having examined the Sierra Nevada and the Coast Ranges, Prof. Whitney, Director of the Geological Survey of California, pushed his investigations toward the Pacific slope. But, between California on the west and the base of the Rocky Mountains on the east, exploited by Hayden, there remained a vast gap of sixteen degrees of longitude which was little known. Under the direction of Mr. Clarence King this gap was very well filled. A general knowledge was acquired of the great mountain system of North America and that in its greatest expansion. We possess now results sufficient to make clear the important problem of the dynamics of mountain chains.

Since 1879 all the geological studies executed at the expense of the central Government have been confided to a single administration bearing the title of the Geological Survey.

Organized by Clarence King, it passed in the following year under the direction of J. W. Powell, in whose able hands it has since remained. Its end, as is defined by the organic law, is the reconnoissance of the geological structure of the country, of its mineral resources, and finally the execution of a geologic map.

The researches carried forward in very different directions of science have been apportioned to many divisions: Geography, geology, paleontology, and others. Geologists, to the number of about twenty, are each one charged with special functions, and their results are gathered each year into a report of the director under the name of Annual Report. It is a large volume published in magnificent shape, in which are likewise collected memoirs upon divers subjects, with an accompaniment of numerous maps, engravings, and photolithographs. Already ten annual reports have appeared.

Besides these reports the survey has published from time to time monographs upon subjects particularly interesting, likewise under the form of very beautiful volumes, accompanied with many figures, and occasionally by a voluminous atlas.

Also under the title of bulletins, of which already have appeared sixty papers relating to subjects new and interesting. And, finally, a statistical publication bearing the name of Mineral

Resources of the United States appears annually and makes known not only the figures of production but also the numerous theoretical considerations which interest the miner.

As to the geographic work which the Geological Survey also possesses among its attributes, a numerous *personnel* of topographers and engineers work actively at the execution of the map in the most diverse parts of the country under the direction of Mr. H. Gannett. Already more than six hundred sheets have been surveyed and drawn, and about four hundred have appeared.

Besides geology and geography ought to be mentioned a considerable work, of which Mr. Powell is the founder, in the domain of the pre-Columbian archæology, the linguistics, the ethnology, and the anthropology of the Indians of North America, splendidly illustrated by Mr. Holmes. The last publication of Mr. Powell upon the classification of American languages is, according to the best judges, of great importance.

Not being able to give here a complete list of all the actual collaborators of the survey, or of their services, we must content ourselves with noticing those who have taken the principal part in the execution of the works already published. These are in alphabetical order: Messrs. Becker, Chamberlin, Cross, Davis, Day, Diller, S. F. Emmons, Fontaine, Gannett, Gilbert, Hague, Hayes, Holmes, Iddings, McGee, Marsh, Newberry, Peale, Russell, Shaler, Van Hise, Walcott, Ward, Upham, Weed, C. A. White, Whitfield, A. Williams, G. H. Williams, and H. S. Williams. It is but just that we should not omit the names of those who are dead: Messrs. Hayden, Irving, Lesquereux, Leidy, Marvine, and Newton; or of those who no longer belong to the survey: Messrs. Bradley, Cope, Curtis, Dutton, Endlich, Hill, Howell, Clarence King, St. John, Stevenson, and Wheeler. Many of these names will remain justly illustrious.

It will be impossible to give in this report even a summary idea of the most remarkable discoveries which are due to the Geological Survey. They belong to branches very diverse: regional geology, monographs concerning metalliferous deposits, general and comparative stratigraphy, mineralogy and petrography, volcanic phenomena, glacial phenomena, ancient Quaternary lakes, and a history of the Atlantic littoral.

Among the most considerable results must be mentioned the paleontological discoveries made in the Rocky Mountains. Since the day in which Hayden undertook his memorable explorations, we have learned that the site of the Rocky Mountains was continuously a part of the continent during the greater portion of the Secondary, Tertiary, and Quaternary epochs. Upon this vast continent the quadrupeds could develop during extended time, freely, without any interruption to their evolution, and thus they

became numerous, gigantic, and sometimes strange. The paleontologists attached to the Geological Survey have brought to light these curious creatures. The monographs of the regretted Leidy, of Cope, and of Prof. Marsh are among the most beautiful paleontologic works accomplished since Cuvier.

Magnificent researches have also been made concerning the invertebrates and the fossil vegetables.

To resume, under the powerful impulse which the Federal Government has given to it, the geologic service of the United States has produced in twenty-five years results very considerable and very skillfully attained. It must be said that in no other region of the globe have been made such discoveries in so short a space of time. Moreover, this organization, all perfect as it is, could not have given such fruits if the galaxy of *savants* who have taken part in it had not given proof, at all times, of a valor and of a tenacity which, in the diverse and inhospitable regions in which they were exercised, recall the heroism of an army attacking the most arduous and most inaccessible obstacles.

The work of the Geological Survey, with the magnificent collection of results that it comprises, merits then that we should render to it a striking homage for the light so vivid and so unexpected that it has thrown upon the geologic history and the mineral riches of North America.

The Cuvier prize is decreed to this grand collective work, not only to the actual collaborators, but also to those who have ceased their labors. It will, we hope, be preserved in the archives of the Geological Survey as a witness of the high esteem of the Academy of Sciences.

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His studies of the planet Jupiter for the past thirteen or fourteen years have satisfied M. Terby that the conditions existing there are more stable than astronomers have of late years been supposing. Even if the phenomena of the spots and bands are atmospheric, their permanency and regularity point to some fixed cause, on the real surface of the planet, controlling them. Besides the "red spot," which has now attracted attention for many years, he finds permanent spots, even on the equatorial zone, having a movement of rotation corresponding with that of this object. The supposition may be legitimately drawn from this fact that this period of rotation agrees with that of the rotation of the planet itself.

At present, the Hon. Rollo Russell contends, in his book on the Causes and Prevention of Epidemic Plagues and Fevers, the science of "public life-saving" is far ahead of the practice. We teach, he observes, in compulsorily attended schools the names of "ancient and unworthy kings," of lakes, mountains, rivers, and so on; while we neglect to instruct in the weightier matters that concern life, health, prosperity, and happiness. The remedy lies in placing the knowledge of the first principles of hygiene within the acquisition of every person of the community.

# HOW SCIENCE IS HELPING THE FARMER.

By CHARLES S. PLUMB, B. S.,
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A SCORE or more years ago, when Horace Greeley and Henry Ward Beecher were telling the American public what they knew about farming, there was quite a general tendency on the part of the agricultural class to hold up to ridicule what was termed "scientific farming." Great claims were then made as to the importance of a knowledge of science, so that the farmer might analyze the soil, crops, fertilizers, etc. Especial stress was laid upon having a knowledge of chemistry, in order to be able to analyze something. Chemistry was to be the panacea for all the farmer's ills, and writers indiscriminately quoted Liebig, Boussingault, Johnston, Lawes, and Gilbert, and other famous agricultural chemists. There was much book farming done that was a source of amusement for practical agriculturists. Much of the written matter and advice published was worthless, and time and the labors of science conclusively demonstrated as much. Early investigators, engaged in faithful and hard work, gleaned much information of scientific importance, and eventually overturned numerous theories that had hitherto seemed plausible. Chief among these was the analysis of soils, whereby one could know the composition of his soil and at once determine in what ingredients of plant food it was deficient, so that he might feed back to it the lacking elements. Time and study have shown that soil is a very complex substance, and one analysis is usually quite unsatisfactory, because a little sample of soil represents only a small piece of ground, perhaps representing quite unfairly the entire field. Consequently, as remarked by Dr. Caldwell,* soil analyses are not thoroughly practical, on account of the difficulty in securing a sample of a few pounds that shall correctly represent the millions of pounds of soil in even a single acre, to say nothing of a field of many acres.

Fifty years ago Justus von Liebig, a German chemist, through an interest in rural economy which resulted in far-reaching discoveries, established himself as the father of agricultural chemistry. His investigations largely related to the composition of the soil and plant nutrition. He was the first to prove that plants fed on certain ingredients of the soil, and that different classes of soils and plants varied in their composition. Liebig's was the pioneer work, and from his time to the present a mass of scientific information has been gradually accumulating that in numerous ways is serving a good purpose.

* Agricultural Science, vol. i, p. 25.

Never before in history have scientific workers been so practical as now. We live in essentially a practical age, and men live better, more intelligently, and more easily than ever before. Practical problems engage the attention of the scientist over all others; and so, instead of ridicule, science as applied to the farm is now receiving most respectful consideration, for the work is practical, and sound practice always receives respectful attention.

Science is knowledge. There is no scientific farming. The highest type of farming is intelligent farming. The intelligent farmer of to-day is simply making use of certain scientific facts that have a practical application.

For a half century science has been laboring in the interests of agriculture. This year the United States appropriates nearly one million dollars for scientific experimentation as applied to agriculture. And yet but few farmers realize how material is the assistance being given the agricultural classes of the country through the direct application of accomplished scientific work. In view of this condition of affairs, in the following pages I propose to give illustrations of what is now in practical use, showing how science has helped and is helping the farmer. These examples signify something. They mean a saving of millions of dollars to the people of the country. Millions have been saved to the farmers in the past; millions will be saved in the future; and all through the aid of scientific research.

The first real substantial assistance received by the farming public from science was in the examination and inspection of commercial fertilizers. Liebig demonstrated that plants secured most of their nutrition from soil ingredients. Nitrogen, potash, and phosphoric acid were those most in demand by the plant, and where crops were removed from the soil these articles of plant food were diminished, thereby reducing cropping capacity. Soil exhaustion in a measure followed if these substances were not returned to feed subsequent crops. Natural manures (animal excrement) contained nitrogen, potash, and phosphoric acid; consequently soil fertility could be maintained by the application of these. But chemistry here came to the farmer's aid, by suggesting that the various essentials of plant food be supplied in artificially prepared form. Nitrogen could be obtained from Peruvian guano and animal matter, potash from wood ashes or German salts, and phosphoric acid from bones; consequently these substances could be supplied as desired. With the propagation of this idea was developed the commercial fertilizer, and artificial manures were made and sold on the market as is any other commodity. However, it was not long before much fraudulent material found its way into the buyer's hands; many dealers were not honest, and farmers were often outrageously swindled. Here,

again, the chemists came to the assistance of agriculture. Fertilizers could be analyzed, their component parts determined, and purchasers might learn how many pounds of plant food a ton of artificial manure contained. Nitrogen, potash, and phosphoric acid each had a commercial value per pound; consequently the chemist could easily determine in a fair manner the value of a ton of fertilizer.

In 1872, through the efforts of Dr. C. A. Goessmann, Professor of Chemistry in the Massachusetts Agricultural College, the Massachusetts Legislature passed a law appointing a State inspector of fertilizers, requiring that all fertilizer manufacturers making a fertilizer having a valuation of over twelve dollars a ton should print on a tag attached to the bag or barrel containing the same the percentage of nitrogen, potash, and phosphoric acid in the brand sold. Samples of all fertilizers selling for over twelve dollars per ton had first to be analyzed by the State chemist before they could be sold in the market; and this officer, designated "inspector," was authorized to sample and analyze any or all fertilizers sold in the State. This Massachusetts law was at first more or less imperfect, but it was later on amended and made eminently satisfactory to both the manufacturer and the consumer. Other States followed the example of Massachusetts, and to-day there is not a State in the Union handling fertilizers to any extent that has not upon its statute-books laws patterned to some degree after the Massachusetts idea, and as a result manufacturers can not with safety sell the farmers shoddy fertilizers. Now and then a fraudulent fertilizer appears, but its sale is quickly stopped by the chemist's exposure. Only a short time ago (the summer of 1890) two fertilizers were suddenly placed upon the Indiana market and sold for $27.50 and $22.50 per ton, respectively. These were analyzed by the State chemist, and the former was found to have a value of $5.76 and the latter of $4.44 per ton. These were out-and-out swindles; yet, had it not been for a prompt publication from the State Experiment Station at Purdue University as to their real character, many farmers of the State of Indiana would have been unmercifully swindled. In view of the fact that millions of dollars' worth of fertilizers are sold yearly in the United States, one can readily understand how great is the sum of money that is being yearly saved to the farmers of the country through the interposition of the chemist.

In the Eastern and more populous part of the United States, which has been long under cultivation, farm manures are more highly valued than in the newer regions of the country. For years investigators have advised that stable manure be handled economically. Chemists argued that, unless properly protected, these manures would lose much of their valuable properties,

mainly through rain leaching away the soluble plant food. Figures supplied from foreign investigation were used to prove the point. Finally, in 1889 the Cornell University Agricultural Experiment Station did some practical work to demonstrate how farmyard manure would deteriorate by leaching and fermentation.* It was shown that one ton of fresh horse manure had a valuation of $2.45, but exposed outdoors for six months its valuation was $1.42, a loss of $1.03 per ton, or forty-two per cent. Mixed horse and cow manure, after leaching for six months, showed a loss of 9·2 per cent, a less amount, no doubt, than occurs on the average farm.

At the present time, while there is a vast loss of plant food to the farms through the improper care of the manure produced thereon, there is at the same time saved to economic use an enormous amount of fertility through the careful husbanding of the materials as produced upon the farms of those who are intelligent and economical. We must give scientific investigation the credit for thus showing husbandmen how important farm losses may be prevented; the numerous devices at present used on the farm for conserving manures, such as manure sheds, pits, cellars, etc., are money-saving equipments.

In a somewhat different direction, yet in a line where the work of the chemist is of equal if not greater importance than in fertilizer control, is the inspection of milk. Milk is the most essential article of food for human consumption, for, properly used, it is as nearly a perfect food as is known. But milk is a fluid, and as such is easily adulterated. It consists of from eighty-five to eighty-eight per cent water, and twelve to fifteen per cent solid substance—as fat, casein (cheesy matter), albumen, sugar, and ash. On the percentage and purity of solids in milk is its quality mainly dependent. After the selling of milk became a recognized industry, adulteration came more or less to be practiced. The pump was brought into requisition. Flour, chalk, and other ingredients were used to thicken it. In 1872 Dr. C. F. Chandler, of Columbia College, stated † that, from long-continued investigation, the milk supply of New York and Boston receives on an average one quart of water to every three quarts of pure milk before reaching consumers. He further says, "With the addition of water in the proportion of one to three before delivering to consumers, we find milk-growers deprived of a business which would return to them $1,390,000 yearly, at an average first price of fifteen cents per gallon, city consumers, on the other hand, paying more than $3,700,000 annually for water."

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* Cornell University Agricultural Experiment Station, Bulletin 13, December, 1889.

† Report of the Commissioner of Agriculture for 1872, p. 335.

Here the dairy farmer was either injuring his own interests or some other fellow was hurting it. The intelligent producer realizes that anything that is done to injure the character of market milk injures the general trade. Were pure milk always placed on the market, a better price could be secured for it, and there would not be the extensive sale for patent baby foods and condensed milk that there now is. To remedy this evil it became necessary to treat milk in a measure as the fertilizers were treated, or, in other words, determine the character of milk by analysis. As in fertilizer control, so in milk inspection, Massachusetts was a pioneer worker. The first act to punish fraud in the sale of adulterated milk in Massachusetts was passed by the Legislature in 1856. This law was ineffective, so in 1859 a new law was enacted, which provided for the appointment of milk inspectors in towns and cities, whose duties it should be to detect adulteration of milk, and secure the conviction and punishment of offenders. This law has since been frequently amended and improved. At the present time the Massachusetts law requires all milk to contain at least thirteen per cent solids, and milk containing less than that amount is condemned. Since the Massachusetts law was first enacted the more progressive dairy States of the Union have passed laws to prevent deception in the sale of dairy products, and usually twelve per cent of solids is required in the milk sold in the market. The London (England) milk supply is carefully watched by inspectors. The Aylesbury Dairy Company of London is the largest of its kind in the world. During 1891 chemists analyzed 21,855 samples of the milk of this company, and found before delivery 12·75, during delivery 12·74, and after delivery 12·81 per cent solids, showing a very good grade of milk.*

That substance which makes milk most palatable is the fat in it. Good milk should have four or five; cream, eighteen to twenty-five, and butter, eighty to eighty-five per cent of fat. Skim milk, or thin, insipid, disagreeable milk, contains a small amount of milk fat. When we speak of rich milk, we mean that which contains a large percentage of this substance. There are in the United States many thousands of cows, each of which does not produce over one fourth or one half the amount of butter it should. The claim is made † that the average yield of our dairy cows is not over one hundred and twenty-five pounds of butter a year, whereas it should be three hundred pounds at the least. Some cows produce a much larger percentage of fat or butter in their milk than do others. The farmer should own the better

* Milch Zeitung, xxi, Nos. 11 and 12.

† The Dairy Industry, by Peter Collier, New York, 1889, p. 8.

class of the two, the butter dairyman can only afford to keep profitable cows, and the thousands of creameries over the country can not afford to purchase good and poor milk for one and the same price, for that is unjust to the person supplying the best grade of milk. Consequently, for some years chemists have been laboring to invent some simple method of determining the percentage of fat in milk, so that creamery men and farmers with a common education might be able to use it, and thus test their milk accurately. The first method for practical application among farmers to attract very general attention was that devised by Mr. F. G. Short, chemist to the Wisconsin Experiment Station, whose method was published in 1888.* This, however, was somewhat complex, and too slow of operation. Other methods were afterward developed by Messrs. Patrick, Parsons, Cochran, Babcock, etc. Dr. S. M. Babcock, while chemist at the New York State Experiment Station, did much valuable work in the study of milk and its products, and in 1889, after becoming chemist of the State Experiment Station at Madison, Wis., he developed and brought out a method for testing the fat in milk or cream that is now a recognized success. The method is simple, and can easily be performed by any person of fair intelligence. Equal quantities of milk and sulphuric acid are placed in specially constructed bottles, and these put in a simple machine, largely consisting of a tin cylinder or wheel, about fifteen or twenty inches in diameter, revolving on its side, within which, after the manner of spokes, are cups or pockets, in which these bottles are placed. The wheel is revolved by a crank and cog movement, and by centrifugal force and the action of the acid the fat in the milk is separated from the rest of the fluid. Enough hot water is added to each bottle to fill the measuring neck, and the fat, after five or six minutes' turning of the machine, comes to the top clear and yellow, after which the amount present may be read upon the graduated lines on the sides of the long neck of the bottle. The milk of as many as twenty-four cows can be tested in an hour. Machines of from four to fifty bottles capacity are manufactured.

This invention, the result of long and laborious scientific research, is not patented, and is largely used in the creameries of Wisconsin, Iowa, Illinois, and many other States in the purchasing of milk. The patrons of the creameries are paid for their milk according to its quality, as decided by the Babcock machine. Such a method as this is a blessing to the country, for it informs the farmer if his milk is inferior to that of his neighbor, and will consequently incite him to improve his stock.

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* University of Wisconsin Agricultural Experiment Station, Bulletin No. 16, July, 1888. A New Method for determining Fat in Milk.

The Babcock milk-testing machine is now just as generally sold by dairy firms as is an improved churn or butter-worker.

One of the most wonderful of agricultural inventions is the centrifugal or milk separator. Briefly, this machine is designed to separate the cream from the milk as soon as drawn from the cow, thus dispensing with the old process of setting milk and waiting for the cream to rise by gravity. At the International Dairy Show at Hamburg, in 1877, an instrument was exhibited* consisting of two wheels in a stand, one of which actuated the other by means of a belt. In the upper wheel four glass tubes containing milk were securely placed, and the lower wheel was then revolved, giving the upper upward of one thousand revolutions per minute. Whirling at this speed brought centrifugal force to bear on the milk in the tubes, and the cream, being lightest, collected at one end and the skim milk at the other.†

In 1879 De Laval, a Swede, exhibited to the British public at Kilburn a centrifugal separator entirely unlike the preceding one, and this machine of De Laval, in principle and general plan, is the form now commonly used over Europe and America. Milk, warm from the cow, is conveyed into a hollow steel drum about ten inches in diameter, which is made to revolve six thousand to seven thousand times per minute within a slightly larger metal chamber. The skim milk, being heavier, is thrown to the outside, and passes off through a tube which rises from a point in the skim milk where the least amount of fat exists to the upper edge of the drum; while the lighter cream rises near the center of the drum and passes off through another hole, coming out of the separator on the opposite side from the skim milk. One or two thousand pounds of milk an hour may be creamed with this machine, when run by horse or steam power. Several other designs of centrifugals have more recently been invented, some of greater capacity than the De Laval, but at the present day the modern De Laval's is unsurpassed. For small dairies De Laval invented a hand separator, which is known as "the baby separator." With the No. 2 size one person can separate the cream from three hundred pounds of milk in an hour, the drum making six thousand revolutions per minute to forty-two turns of the crank.

The manufacture of this cream separator has been followed by the invention and introduction within the past two years of a combined cream separator and butter extractor, which makes it

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* Sheldon, Dairy Farming, p. 303.

† An editorial in Farm and Fireside, for June 1, 1892, states that the cream separator has been in process of evolution for thirty-three years, and that the first known application of centrifugal force for creaming milk was made in 1859. Dairy authorities, so far as I can learn, give no data on the subject preceding that quoted above in the text.—C. S. P.

practicable to run milk into the machine and take from it butter, thus avoiding the handling of the cream at all.

The cream separator enables the dairyman to dispense with numerous utensils ordinarily used in setting milk, and in hot climates is invaluable, as it saves much of the great expense of ice. Centrifugal cream is unexcelled. In a comparatively few years these valuable dairy utensils will be commonly found in use on the dairy farms of the country.

Never before in the history of man have agricultural plants apparently suffered so greatly from parasitic vegetable growths and injurious insects. The conditions of growth have been made so much more intense for many plants that they have in consequence, in certain directions, thus made themselves more vulnerable to the attacks of parasites and insects. Some insects have been deprived of their normal food in a large degree, and have sought sustenance in agricultural crops. The destruction of these ravagers meant the saving of valuable crops; consequently much important experimental work has been accomplished with fungicides and insecticides.

For two score of years the grape rot has caused immense damage in the vineyards of the Eastern United States. A small plant, so minute as to require a high-power microscope to bring it to view, feeds upon the juices of the tender leaves and berries of the grape, blasting and ruining the fruit. The parasite matures and ripens its spores or seeds in vast quantities, and these are blown over adjacent vines and the disease more widely scattered.

Within a few years the botanists of both Europe and America began to devise means to prevent this malady. After long experimental work with fungicides and spraying machines, a mixture of sulphate of copper (six pounds), unslaked lime (four pounds), and water (forty-five gallons), termed Bordeaux mixture, was adopted,* which, when sprayed on the vines several times during the growing season before the grapes became ripe, completely prevented the ravages of the rot. Applications are made after the buds have started, and four or five times later on. Experiments, generally conducted by scientists with the Bordeaux mixture, have shown it to be most excellent for preventing numerous diseases of plants caused by parasitic growth. The method is cheap, and small hand machines, or large pump tanks with spraying attachments and drawn by teams, are made, by which one can rapidly and effectively spray large areas at comparatively slight expense. So extensive is the use of Bordeaux mixture becoming that all along the Hudson and in other grape regions, in

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* American Gardening, April, 1892, p. 260.

vineyards of the country, this is the method employed to save the crop from black rot, mildew, etc.

In the cereal-growing regions, oats and wheat are frequently damaged by the ravages of smut, a disease nearly all farmers are familiar with, which destroys the seed or the entire head. This smut is a mass of spores or seeds of a parasitic plant ripened in the seed grain. The spores are scattered over the field, and mingle among the grain when thrashed out. The grain is planted in the fall or spring, and the spores of the parasite germinate and grow along with the young plant, feeding on its juices. When the head of the plant begins to mature its seed it is blasted by the smut.

A simple remedy has been devised to combat the smut of oats and what is known as "bunt" or stinking smut of wheat. Investigations begun by Prof. Jensen, a Danish scientist, and also conducted at the Kansas and Purdue University Experiment Stations, conclusively show that by soaking the seeds of these cereals in water at a temperature of 135° to 140° Fahr. for five minutes all the spores were killed, and the crop from the treated seed would grow free of the malady. This simple method, costing nothing for materials, bids fair to be extensively used in future. It is estimated, as a result of investigation, that ten per cent of the oat crop is destroyed by smut. In 1889 the oat crop of Indiana amounted to 28,710,935 bushels. The value of the estimated ten per cent of loss is $797,526 for 3,190,104 bushels of oats at 25 cents a bushel. Certainly, if this sum can be saved it should be.

Few people realize the enormous loss to agriculture through the ravages of insects. In his annual address before the Association of Economic Entomologists at Washington in August, 1891, Mr. James Fletcher, the president, gave important facts concerning the extent of the losses from insect ravages. In 1864, Dr. Shimer estimated the loss to the corn and grain crops of Illinois to be $73,000,000. In 1874, Dr. Riley estimated a loss to Missouri by insects of $19,000,000. In 1887, Prof. Osborne, of the Iowa Agricultural College, estimated the loss to Iowa by insects at $25,000,000. Mr. L. O. Howard, in 1887, estimates $60,000,000 losses from chinch bug in nine States; and Prof. Comstock estimates that the cotton *Aletia* in 1879 caused a loss of $30,000,000 in the cotton States. Finally, Mr. Fletcher estimates $380,000,000 as the sum total per year for losses from insect ravages.

There are numerous illustrations available to demonstrate how great are the services of scientific research, from an entomological point of view, to agriculture, but I will refer to only three, as these are of striking interest and serve to illustrate the work.

The citrus industry of California is a great one, involving

hundreds of thousands of dollars. What is known as the fluted scale insect had for about twenty-five years a foothold in the orange and lemon groves, and bade fair to cause enormous losses to the orchardists. A study was made of the parasites affecting this scale insect, and in 1888 the United States Government sent two entomologists to Australia to study the parasites of the scale insects in that country, and bring live specimens to California to distribute in the orange and lemon groves. Suffice it to say that these parasites rapidly multiplied and fed upon both the white and fluted scale, to their destruction. With surprising rapidity the beneficial insect destroyed the injurious one. Says Dr. C. V. Riley, United States Entomologist,* "The history of the introduction of this pest (scale insect), its spread for upward of twenty years, and the discouragement which resulted, the numerous experiments which were made to overcome the insect, and its final reduction to unimportant numbers by means of an apparently insignificant little beetle imported for the purpose from Australia, will always remain one of the most interesting stories in the records of practical entomology."

I have just quoted Mr. Howard's statement that the chinch bug in 1887 caused $60,000,000 of losses in nine States. A few years ago the attention of entomologists was drawn to the fact that chinch bugs occasionally died in large numbers from a peculiar disease. The bugs were found on the ground dead and covered with a white fungus. This disease seemed to be infectious, and several entomologists gave special attention to the matter. Prof. F. H. Snow, of the University of Kansas, pushed the investigation and thought it possible to artificially induce the disease and communicate it to healthy bugs, and thus diminish their numbers, and for the past three years Prof. Snow has worked upon this line. The Legislature of Kansas appropriated $3,500 for carrying on his investigations during 1891–'92.

In his annual report to the Governor of Kansas, describing his investigations, Prof. Snow gives a list of 1,400 persons who conducted experiments under his direction in 1891, to assist in disseminating the disease. Of these 1,071 were successful, 181 unsuccessful, and 148 doubtful, in their attempts. As a result of their season's work, Prof. Snow estimates that, on the basis of the reports rendered, $200,000 in crops were saved to those 1,071 persons who worked under his instruction.† Four hundred and eighty-two farmers reported to him an estimated saving of $87,244.10 through scattering the diseased insects among the healthy, thus

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* United States Department of Agriculture Report, 1889, pp. 334, 335.

† University of Kansas Experiment Station, First Annual Report of the Director, for the Year 1891, p. 171.

resulting in the rapid destruction of all. While this is experimental work, and may not invariably give the satisfactory results to be wished for, it illustrates in a striking manner one way in which science is working in the interests of agriculture.

In 1887 what is known as the gypsy moth (*Ocneria dispar*) was discovered in eastern Massachusetts. This insect was originally brought to Massachusetts from France, where it is exceedingly destructive to vegetation, and especially the foliage of trees. When first found in Massachusetts its character was not known by the finder, but when later examined by Prof. Fernald, of the State Agricultural College, he, knowing its nature, at once began an investigation to ascertain how much of a foothold it had in the State. It was located in numerous towns. The Legislature was advised of the dangerous character of the insect. A State law was enacted to provide against the depredations of the gypsy moth. Several commissioners were appointed and money appropriated to eradicate the insect. During the entire growing season of 1892 bands of men were engaged in destroying this insect in its various forms, and every effort is being made to prevent its further increase.

Perhaps the most serviceable labor given by science to the cultivator, in its application to insects, is the invention and perfection of insecticides. A great number of experiments have been conducted in agricultural colleges and experiment stations over the country with solutions and powders with which to kill injurious insects. Arsenic in different preparations, carbolized plaster, kerosene, hellebore, pyrethrum, hot water, and Bordeaux mixture have been in use and tested in many ways, so that, as a result of this work, standard insecticides can be recommended to farmers generally, which may be easily made at home out of simple ingredients. What is termed the kerosene emulsion is perhaps, all things considered, the best general insecticide in use. This may be made as follows, following Cook's directions: * Dissolve in two quarts of water one quart of soft soap or one fourth pound of hard soap, by heating to boiling; then add one pint of kerosene oil, and stir violently for from three to five minutes. This can then be diluted with twice its bulk of water for use. This emulsion will destroy lice on both live stock and plants.

Finally, we have in the United States nearly fifty experiment stations where trained men are working in the interests of agriculture—men whose one aim is to conduct research of benefit to mankind. Considering this fact, and that numerous scientists outside of the stations are also engaged in a class of work that of

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* Michigan Agricultural Experiment Station, Bulletin 76, October, 1891, p. 5. Kerosene emulsion.

necessity is of value to agriculture, farmers should feel satisfied that their interests are being well looked after outside the pale of politics. It requires no effort to emphatically show that already many, many millions of dollars have been gained to agriculture through the disinterested efforts of scientists. Scientific investigation will continue in the future as it has in the past, and it is fair to assume that each year will see much good work done. Certainly no other class of labor is receiving greater benefits from science than is agriculture at the present day.

## DIETARY FOR THE SICK.

By Sir DYCE DUCKWORTH, M.D., LL.D.,
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HON. PHYSICIAN TO H. R. H. THE PRINCE OF WALES.

IN the practice of medicine as now carried on, one marked feature is the particular and detailed attention directed to the diet. It thus happens that as much heed is paid to "kitchen physic" as to pharmaceutical agents. Dietetics, according to modern enlightenment, has secured careful study, more particularly within the last quarter of this century, and the subject was certainly insufficiently appreciated before that time. Now, guided by the researches of the physiologist and the chemist, we have more exact knowledge to bring to bear in the dietetic treatment of many morbid states, and a good deal of this knowledge is now well established and beyond dispute.

The duty of the practical physician is to apply this knowledge and to test it in his efforts to re-establish health. And here, as in the case of the employment of drugs, we have to consider the *clinical* side of the question, apart from the researches of the physiologist and the chemist in their laboratories. The progress of our art depends on the steady work of both sets of investigators. The ultimate appeal is to the clinical results. In the matter of diet we meet with strange differences of opinion—differences relating to the employment and value of sometimes very simple forms of aliment. Some of these plainly arise from ignorance in respect of the properties and qualities of certain foods. Some of them result from the foisting of mere personal or of very limited experience of such articles on patients; and some of them can only be described as mere vagaries and "fads."

The whole subject has naturally a large interest for several classes of patients, notably among the well-to-do, the luxurious, the hypochondriacal, and the dyspeptic. Such persons having exhausted many methods of drug treatment, resorted to spas,

undergone massage with incarceration, and found temporary salvation in sipping hot water, pass from one consultant to another seeking the last new paradox in dietetics. They will continue to do so, and the more if they fall into the hands of those who give them really judicious advice. They dislike that, and it is indeed seldom helpful to such persons. In this brief communication I shall have nothing to say in respect of them.

We may fairly remark that we are in danger of being perplexed by the number of patent and proprietary articles of food daily brought under our notice. The chemists, especially the Continental and American, try to help us in our daily work by contriving the most subtle, and often palatable, preparations of nutrient materials. And, not content with this, they would fain abolish almost the entire *Pharmacopœia*, and offer food and physic in one; aiding themselves in this bold effort by the most fantastic and obtrusive advertisements, which pass one's best ingenuity to escape from. Strange to say, they compel attention from persons who should know better, and should use calm judgment in sweeping most of them aside. So it happens that one frequently finds many of these vaunted preparations in use by persons who have not even a bare knowledge of their qualities and powers for good or evil.

The mischief of all this in respect of foods and new drugs is, as I have before now stated, that the practitioners in trying, as they think, to keep pace with the times, lose their hold of well-approved methods and therapeutic agents, which drop out to make way for something new and unapproved. They thus fail in the *art* of medicine, which I make bold to say is less well established to-day than it was, in many respects, half a century ago, and chiefly because of this pursuit of novelties.

We have witnessed many changes of opinion respecting some of the commonest articles of diet for the sick. The old view, that calves'-feet jelly was of exceeding nutritive value, was at one time so controverted that the jelly ceased to be much used. It is now sanctioned as having a place in dietetics, and I believe it may be safely regarded as a temporary form of nourishment of no inconsiderable value.

Beef-tea has been in and out of repute, but we have, or should have, no doubt now as to its stimulant and reparative properties. We can not think lightly of it as commonly prepared, for it can certainly prove harmful, when not desirable, as in the case of rheumatic fever. I believe it is right to withhold it in such cases. Again, it is so far apt to act as an aperient that it is best not to employ it in enteric fever, or in diarrhœa, when the bowels are in an irritable condition. Mutton, veal, or chicken essences can, however, be used, having no such aperient action. We have to

distinguish between a dietary suitable for acute disease, when we have to wait and tide over difficulties, and one that may be better adapted to restore a convalescent or weakly patient. The highest nutritive value may not be (I think it is not) the most essential point to have regard to in selecting a dietary in acute diseases.*

In most cases of acute disease, beef tea, freshly prepared, can well be taken and digested. It is now often peptonized, and I believe for clinical purposes this is generally unnecessary, unless there is manifest failure of secretion of gastric juice. This remark applies equally to milk, which is also too often given peptonized. I feel sure that we do best to administer nutriment in the most natural and unaltered forms when possible—that is, with as little of culinary or medicinal interference as may be; to give it, in fact, fresh from Nature's laboratory.

In many illnesses it is well to vary the broths given, changing from beef to mutton, veal, or chicken, and so providing variety for the patient. Milk and veal broth may often be given together. Alcoholized liquids are best not administered with animal broths. These are better given separately, but brandy, rum, or whisky may be given with milk.

It is, unfortunately, a good rule to boil milk before using it, especially in the case of children and young persons. This no doubt averts many of the evils of milk diet, and may also prevent some specific diseases. I say *unfortunately,* because I suspect boiling much damages the nutritive value of a secretion such as milk. Dilution with barley water, lime water, or the addition of sodium bicarbonate, certainly aids its digestibility in children and adults, both in health and disease; the bicarbonate being preferable if there is constipation. Whey is of considerable value for many dyspeptics, and also in enteritis, typhlitis, and intestinal obstruction, and may be freely given. Isinglass boiled in milk is very useful, and children readily take this in the form of *blanc-mange* when not too firm in consistence. Alum whey is of much avail in diarrhœa, and in cases of enteric fever with hæmorrhage. One drachm of powdered alum is added to a pint of hot milk, and the whey strained off. Cream with an equal volume of hot water can often be taken when milk disagrees.

Koumiss has considerable value in cases of great irritability of the gastric mucous surface. Koumiss one week old I find the most useful, and I have often known troublesome vomiting checked by it. Few plans are better than that of employing milk with one

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* Thus alcohol, which is by some denied to have any nutrient property whatever, will, with water, maintain life for days in some cases of acute illness, to the exclusion of any other articles of diet. I consider alcoholized liquids as *food,* for both ordinary and clinical purposes

third of its volume of lime water, given in teaspoonful doses each quarter of an hour by the clock, in rebellious vomiting of reflex origin. This quantity will be retained when larger ones will be rapidly rejected.

The inability to digest amylaceous food when pyrexia is present is generally recognized: hence the principle of milk and beef-tea diet in fever. I would strongly urge the employment of occasional draughts of pure water in fever. This is much neglected. Patients are plied with strong essence of beef, Brand's jelly, and milk with stimulants—all this *ad nauseam*, but a cooling draught of water is withheld. Water, however, is generally relished, and is of real service. It promotes appetite for the next food, and cleans the mouth.

The nutritive value of purely amylaceous foods has been decried, but, I think, with no satisfactory clinical reason. Arrowroot prepared with water only, or with milk, is certainly sufficiently sustaining for many invalids who temporarily can not take bread. In gastric and gastro-enteric catarrh it is of much service, and diarrhœa may sometimes be checked by stirring into a cupful of milk-arrowroot half a teaspoonful of raw arrowroot powder, and ten grains of powdered cinnamon.

Eggs often disagree because of their albuminous constituents. The yolk alone can often be taken with advantage in soup or in milk, or beaten up with spirit.

In the treatment of febrile states, tea and coffee are too often omitted, without reason, from the dietary. They will enable cases to go on well with a diminished amount of alcohol. Cold tea with cream is an excellent refreshment early in the morning after profuse sweats in phthisis. One meets with patients who have been forbidden butcher's meat, but allowed to eat chicken or game. I am at a loss to understand the reason for this. I recognize the greater digestibility of the latter as a rule, although I much doubt if there is really any difference if the beef or mutton be tender and of good quality. If, as I conceive, there is an idea that the one tends to plethora and vascular tension, or is apt to induce uric-acid disturbances, while the other does not, I should be prepared to controvert that idea, believing that all these flesh foods fall into the same category. With fish the case is different, and large meat-eaters may sometimes with advantage be ordered to substitute fish. It is hardly possible for any one to overeat himself on fish, and, whatever may be the explanation of the fact, I am satisfied that great mental energy and capacity may be secured by occasional meals of white fish to the exclusion of other animal food.

It were well if greater heed were paid to the treatment of the patient than is commonly bestowed on that of the disease. One not rarely finds measures adopted for the latter, and no thought

bestowed on the subject of it. It is always necessary to treat the patient, and sometimes what is seemingly necessary for his ailment is very poor treatment for him, if too long kept up. We especially note this in respect of the employment of wine and stimulants, and in the conduct of cases of Bright's disease and of chronic gout.

I think well of the skim-milk treatment in cases of chronic tubal nephritis. But it is not always well borne by the patient. He may fail to be sufficiently nourished by it, and a time comes when the diet must be altered. There is a large variety of foods available in this condition: bread, biscuit, butter, light farinaceous pudding, sometimes with egg in it, potatoes, spinach and other green vegetables, with cooked fruit. The albuminuria is often not materially increased in chronic cases if fish be given once a day, or the yolks of two eggs be added to the diet. Fat bacon may also be taken. And on alternate days we may sometimes give a little mutton or chicken, without any apparent harm to the disease, and with material benefit to the patient. The condition of the urine must be carefully noted in making these amendments. Certainly, in some cases, the "large white kidney" is an expression of a frail and feeble constitution, and has not always the same significance. A better level of general nutrition, directed in relation to the renal adequacy, may much aid in helping the kidneys to recovery. It is surely wrong to starve the patient while aiming only to rid him of his ailment. Of course, age, habits, constitution, and tissue-proclivity must be had regard to in all such cases.

The treatment of acute phases of dysentery by absolute milk diet I believe to be excellent; and I agree with those Indian authorities who forbid the least addition of animal broth or of farinaceous matters to it, possibly for many consecutive weeks.

In many cases of gout and gouty habit of body I often find inadequate diet prescribed, and a frail, painful condition of body as the result. In such cases, again, each person is to be studied as to his previous habits, inherited proclivities, and textural condition. The prohibition of meat and wine is often bad, and gouty manifestations will be held in check, not seldom, by a good diet and the use of some trustworthy wine. The tendency now is to make all gouty persons avoid meat, and drink whisky in routine fashion, or to take to water-drinking. The latter plan has its place, but many sufferers from gout, in both sexes, are better with some wine. If they starve themselves of what they formerly took, perhaps in moderation, and of what their progenitors took perhaps too freely, they will not so much have gout as gout will have them—as has been quaintly remarked. Such persons must attain their highest level of good health, and live above their

gout, or they will never be free from untoward symptoms, and will become miserable. Water-drinking at this stage of our social evolution is not, I feel very sure, the *summum bonum* for humanity.

The tendency to drink whisky, now so common, is not all due to medical prescription, as is often alleged. If good wines were readily procurable at fair prices, especially at hotels, more would be drunk. People resort to whisky because they know it is commonly to be depended on, whereas wine is dear and bad, and they seek at once to relieve their digestion and save their purses. They take far more alcohol, and lose the wholesomeness of the many other good things to be found in a moderate use of honest and sound wine. "Cheap claret" has done no good in England, but much harm, and intelligent persons now hardly know the difference between a vintage of the Médoc and the abominable stuffs that issue from Bordeaux, gathered from all other wine-growing countries, and called "claret." This has been well termed "red ink at a shilling, or, it may be, six shillings, a bottle." These compounds are disastrous to digestion, and it is small wonder that invalids and others resort to whisky. Real Médoc wine is never advertised for sale, but consumers have now ready means of knowing where to procure it.

The present agitations in favor of temperance, which should rather be termed efforts to abolish all alcoholic drinks, have, I believe, led members of our profession to neglect this important part of the subject of dietetics, and prevented their gaining an adequate knowledge of the nature and qualities of wine, a knowledge every physician should possess. Were this more commonly in possession, we should not hear such discrepant statements respecting wines dogmatically laid down by members of our profession.

Perhaps I should offer an apology for many of the remarks I have ventured to make in this communication, both because I have set down little that is new, and may also have appeared to uproot some well-grown opinions. I will only add, however, that I believe I have stated nothing that will not be found to be true and helpful in the daily practice of our art.—*The Practitioner.*

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A novelty in scientific photography is the photograph of a meteor, which was obtained by Mr. John E. Lewis, of Ansonia, Conn., while trying to photograph Holmes's comet. The path of the meteor is shown as a bright, clear-cut, almost straight diagonal line running across the plate, and reaching across about eighteen degrees of the heavens. Where the line enters the field it shows minute variations indicating irregularities in the amount of the meteor's light; the rest of the line is sharp and level, and of about the breadth of a lead-pencil mark. At every point it appears brighter after only an instantaneous exposure than any of the stars, which were subjected to an exposure of thirty-three minutes.

## SKETCH OF SAMUEL WILLIAM JOHNSON.

PROF. SAMUEL WILLIAM JOHNSON is eminent for the services which he has rendered to scientific agriculture as an experimenter, a contributor to its literature, and a teacher; and for his agency, always active and earnest, in securing the introduction of whatever could advance its standards or add to the prosperity of the farming interest. A descendant of Robert Johnson, one of the founders of the town of New Haven, he was born in Kingsboro, Fulton County, New York, July 3, 1830. When he was four years old the family removed to Deer River, Lewis County, in the "Black River country." He was taught in the common school and in Lowville Academy, where he studied Latin, Greek, French, algebra, physics, botany, and chemistry. His home, says the American Agriculturist, was upon a large, productive, and well-managed farm, where he became familiar with a wide range of agricultural practice. He taught in the common schools during the winters of 1846–'47 and 1847–'48, and during 1848–'49 was teacher of natural science in the Flushing Institute, Long Island. In 1850 he entered the Yale Scientific School, where he spent eighteen months under Profs. John P. Norton and B. Silliman, Jr., studying agricultural chemistry. He served during the winter of 1851–52 as instructor in the natural sciences in the New York State Normal School at Albany. Having spent the succeeding winter in work in the laboratory at New Haven, he went to Germany in January, 1853, where he spent two years in study at Leipsic and Munich, under Erdmann, Liebig, von Kobell, and Pettenkofer. Thence he went to England, visiting the Paris Exposition on the way, and spent the summer of 1855 in study under Frankland.

In September, 1855, he became Chief Assistant in Chemistry in the Scientific School of Yale College, and took charge of the laboratory. The next year he was appointed Professor of Analytical Chemistry in that school, and in 1857 he took charge also, succeeding Prof. John A. Porter, of the chair of Agricultural Chemistry. In 1875 he became Professor of Theoretical and Agricultural Chemistry; and, in addition to the performance of these several duties, he has taught organic chemistry since 1870.

With the establishment of the State Board of Agriculture of Connecticut in 1866, Prof. Johnson was constituted one of its members. On expiration of his term of service, two years afterward, he was appointed chemist to the board, and has served in that capacity ever since. He began to advocate the establishment of a State Agricultural Experiment Station as early as 1873. The act of the Legislature organizing the station was passed in

1877, and, on its going into effect, Prof. Johnson was appointed director. "For many years," says the Rural New-Yorker, "the station was confined to two small rooms, and the appliances and works of reference were for the most part loaned from Yale College or borrowed from the professor's private laboratory and library."

Mr. Johnson began his literary work while still a student, writing for the agricultural papers. Among the earliest of his publications of general interest was an address before the State Agricultural Society of Connecticut, in 1866, on Fraud in Chemical Fertilizers. This was followed by the adoption of measures intended to protect buyers of fertilizers against imposition through adulterations. As chemist to the State Agricultural Society he made a series of reports on fertilizers in 1857, 1858, and 1859, by means of which knowledge on the subject was extended, and frauds received a further check. Besides his official reports, "which have been models for works of their kind," Prof. Johnson's writings include many contributions to the agricultural press, which have been highly appreciated, and several books on the special subjects of his studies. The best known of these are How Crops Grow; How Crops Feed; Peat and its Uses as Fertilizer and Fuel. The earliest and best known of these books—How Crops Grow, published in 1868—embodied the results of stvdies undertaken by the author in preparing instruction in agricultural science. Together with its companion volume—How Crops Feed—it was intended to present concisely but fully the state of the science at the time regarding the nutrition of the higher plants, and the relations of the atmosphere, water, and soil to agricultural vegetation. In it the chemical composition of agricultural plants was described in detail, the substances indispensable to their growth were indicated, and an account was given of the apparatus and processes by which the plant takes up its food. The book was received with great favor in America and in Europe. It was republished in England under the joint editorship of Profs. Church and Dyer, of the Royal Agricultural College at Cirencester; a translation of it was published in Germany under the instigation of Prof. Liebig; and other versions of it have been made in Swedish, Italian, and Japanese, and twice in Russian.

In view of the great advance that had been made in all branches of science, a new edition of How Crops Grow was issued in 1890, in which the purpose was guarded of bringing the treatise up to date as fully as possible without greatly enlarging its bulk or changing its essential character.

The account of the sources of the food of plants, which were noticed in this volume in only the briefest manner, was reserved

for the next book, its complement, How Plants Feed, published in 1870. It was exclusively occupied with the subject of vegetable nutrition. The writer, the author said, did not flatter himself that he had produced a popular book. "He has not sought to excite the imagination with high-wrought pictures of overflowing fertility as the immediate result of scientific discussion or experiment; nor has he attempted to make a show of revolutionizing his subject by bold or striking speculations. His office has been to digest the cumbrous mass of evidence in which the truths of vegetable nutrition lie buried out of the reach of the ordinary inquirer, and to set them forth in proper order and in plain dress for their legitimate and sober uses." The author's method was to bring forth all accessible facts, to present their evidence on the topic under discussion, and dispassionately to record their verdict. The books were therefore commended to students of agriculture on the farm or in the school. Besides these books, Prof. Johnson edited Fresenius's Quantitative Analysis, and two editions of his Qualitative Analysis.

The American Agriculturist names Prof. Johnson as one of the trio, consisting of Johnson, Gössman, and the late Dr. Cook, of New Jersey, "who have done so much for agricultural science and experimentation."

The purposes and efforts of Prof. Johnson to make the Connecticut Agricultural Experiment Station of practical benefit to farmers are obvious to every one who inquires into the character of the work done there, or who will peruse a series of the reports of the institution. These reports are consistently animated by the single thought of those particular features of agricultural science in which the farmers are most immediately interested. One of the predominant crops of the State is grass; the thing the farmers most need to make their agriculture profitable is economical and efficient fertilizers. Accordingly, we find these among the subjects most conspicuously presented. It would be impracticable to go over all the reports seeking instances of this happy adaptation of investigations to the peculiar wants of the people whom it was the station-director's purpose to serve; but two or three from the later reports will illustrate this characteristic of his work. Attention is directed in the report for 1886 to the important relation of the mechanical constitution of soils to the growth of plants. Very little practical benefit, the author observes, is commonly obtained from the analysis of any special soil beyond the detection of some deleterious ingredient, or proving the relative deficiency of one or more needful elements. In most of the cases where the station had undertaken to make soil analyses, the results had probably disappointed those who supplied the samples. It was pointed out as an obvious defect of the

ordinary chemical analysis that it could give at the best only an imperfect or one-sided view of the character of the soil. Two soils might agree fairly in chemical composition, and yet differ extremely in their fertility. Again, two soils might be about equally productive, and yet have unlike chemical composition. The physical characters of a soil—the texture, porosity, tenacity, amenability to tillage, retentiveness for water, capacity for heat, etc.—equally with the chemical composition, influence its productiveness and value. These considerations had been appreciated for a long time, attempts had been made to take account of the physical capacities of soils; and of late years much attention had been bestowed upon their mechanical analysis—that is, on separating into various grades, according to the dimensions of their particles. Such mechanical analysis was in most cases essential to any conclusive investigation of a soil.

In the report for 1887 the intention was declared to include in the forage garden of the station specimens of all the grasses found in Connecticut. There were about one hundred and twenty species of grasses in the State, of which eighty-one were then growing in the garden. Prominence was given to persistent meadow, pasture, and lawn grasses, and to those which continually reproduce by culture and seeding; also to other forage plants, sedges, etc. The question of methods of improving Connecticut grass lands so as to make them more productive and more permanent, wherever that was desirable, was declared a question of the first importance. To answer such questions, it is needed to know more about the plants of this character which would grow in the State with less care than others, and with no expense for seeding, their habits of growth, seed production, fitness for meadow and pasture on different soils, feeding value, rooting peculiarities, growth with other varieties, possible improvement by cultivation or by selection of seed, and the effect of different fertilizers. A more general and closer observation of the appearance and behavior of all the useful grasses was also needed, so that they might be known by botanists and farmers at sight through the spring, summer, and fall. Names were needed, also, which should be current everywhere, free from all confusion; because without names there could be no discussion of grasses away from the grasses themselves.

With this eminently practical direction and purpose of his work, Prof. Johnson is a devoted student of science, and an earnest advocate of scientific methods of investigation. He has a pleasant, modest manner, a full knowledge of human nature, and "a practical conception of what farmers want of agricultural experiment stations." As a writer, "his style is clear and concise, yet delightfully smooth, and most agreeably finished."

# EDITOR'S TABLE.

## *SOUND WORDS ON EDUCATION.*

THE article of President Eliot to which we called attention three months ago dealt with the subject of education mainly in its intellectual aspect. In a recent number of the Contemporary Review we find an article entitled The Teacher's Training of Himself, which discusses the same subject, but mainly from the moral point of view. The author is Dr. Weldon, head master of Harrow, and the article is a reproduction of an address delivered by him before the Birmingham Teachers' Association. Seldom, if ever, have we found more of sound sense and right feeling in any discussion of the general subject of education than is contained in this essay of Dr. Weldon's. From first to last it may be said to be a plea for that which, according to Dr. J. M. Rice, is so conspicuously lacking in most of our own public schools—sympathy. The writer sees that this, above all things, is needed to vivify education and make it what it ought to be, a blessing both to the giver and the receiver—to prevent it, indeed, from becoming positively injurious in its effects. Is it due simply to mental inertness and inferiority on the part of the mass of society that there is on the whole so little love of knowledge and so little pleasure in intellectual effort? May it not be in a measure due to the fact that in childhood the acquisition of knowledge was carried on under more or less repulsive conditions with the mental faculties only half aroused and the sympathetic or emotional nature wholly untouched, except in so far as it may have been moved to opposition?

It is the first step, says Dr. Weldon, in the teacher's self-culture to realize the dignity of his profession, which, though it may lack the distinction belonging to the pulpit, the platform, or the bar, has "this signal advantage, that in all its branches and among its humblest no less than its highest representatives, it aspires constantly to two objects that are among the worthiest of which human nature is capable—namely, the promotion of virtue and the increase of knowledge." He places the promotion of virtue first, but in actual practice we fear that the amount of attention given in public schools of the ordinary type, here or elsewhere, to that special object is far from commensurate with its recognized importance. The discipline of the school is often said to be of itself a powerful moral influence; and so it would be if the discipline were maintained in any large degree by the help of sympathy; but if it is enforced in the thoroughly unsympathetic way described by Dr. Rice we fear it can hardly be counted on for any very moralizing effects.

We must, however, pass over much that we would wish to note in Dr. Weldon's address, in order to leave space for a few of his more striking remarks. The following are worth quoting and remembering:

"If a teacher is to train others, still more must he train himself. . . . The reason is that the influence of every teacher depends not upon what he says, nor even upon what he does, but upon what he is. He can not be greater or better than himself. He can not teach nobly, if he is not himself noble.

"It is sadly true that we as teachers may make mistakes. We may break the bruised reed; we may quench the smoking flax. By making the young dislike us we may make them dislike the subjects we represent. Strongly would I impress upon you and upon myself the terrible responsibility which belongs to

us of making one of these little ones to offend. Perhaps if I might sum up in a single phrase the teacher's true temper toward his pupils, especially boys in a large school, I should say it is one of *sympathetic* severity. . . . Severity is not worth much if it stands alone. It may be said that severity without sympathy is a guarantee of failure.

"There is one word, and only one, that I have simply begged my colleagues never to use in their reports of boys—the word 'hopeless.' Masters and mistresses may perhaps be hopeless, I can not tell; but boys and girls—never.

"An angry schoolmaster, or rather a schoolmaster who can not control his anger, is the drunken helot of the profession. In an angry moment words are spoken, deeds are done, that are irreparable. Fling away from you the poisoned shafts of sarcasm; they are forbidden to the humanities of school life.

"It appears to be the particular danger of schoolmasters and schoolmistresses that their profession has naturally a cramping or narrowing influence upon the mind; it is therefore the primary duty of all teachers to take every opportunity of enlarging and liberalizing their views. The schoolmaster must not be a schoolmaster only; he must be more than a schoolmaster. He must be a man of wide interests and information; he must move freely in the world of affairs. Fill your pitchers, however humble they may be, at the wide and ever-flowing stream of human culture. It is my counsel, as a precaution against narrowness, that you indulge largely and lavishly in reading. You can hardly read too much. It may be a paradox to say so; but I doubt if it matters much what you read, so long as you read widely. . . . Novel-reading I conscientiously recommend. It will take you out of yourselves, and that is perhaps the best holiday that any one can have. It will give your minds an edge, an elasticity. The peril of reading no novels is much more serious than that of reading too many. . . . Apollo himself does not keep his bow on the stretch forever, and most of us need relaxation as much as Apollo."

The above is good advice, and happy is it for those who can take it to heart and act upon it—for those whose faculties have not been already so deadened by a mechanical routine as to be incapable of the ambition of individual culture. Dr. Weldon speaks and writes from the elevated standpoint of head master of one of the great English public schools, a position of as great independence probably as any the educational world affords, and one in which there is infinite scope for the exercise of individuality. The position of the average public-school teacher is very different. To the latter functionary individuality may be a personal advantage, but it may easily become, from a professional point of view, a burden and a drag through the lack of encouragement or even opportunity for its exercise. That the advice given by Dr. Weldon as to reading is not very widely followed out by teachers in this country was proved some few years ago by some one who took the trouble to write to all the principal public libraries to ascertain to what extent teachers took advantage of the privileges which these institutions afforded. We forget the precise result of the inquiry; but it showed that the teachers, as a body, used the libraries almost less than any other class of the community. We recall this fact in no unfriendly spirit, but solely with a view of showing to a public that is hard to convince on this point how far we are from having as yet commanded the most successful conditions for general education.

### *THE SCIENTIFIC ALLIANCE.*

The formation of the Scientific Alliance of New York marks an important step in the scientific movements of this city, and will not be without beneficial influence, we believe, in the advancement of research in the country at

large. New York, long recognized as the great financial and commercial center of the Union, and pre-eminent in some other departments of the life of the century, has not been eminent in science. It has, indeed, as President Low said at the late joint meeting of the Alliance, many scientific men of the first order, and has a record of scientific work of the highest character that has been done by such men as Draper, Morse, Rutherfurd, Newberry, and Edison; but the fame of that work has been dissipated: it has never been concentrated, as in other metropolitan cities and many much smaller towns, under the panoply of a single organization, central for all the branches of research. London has its Royal Institute and Royal Society; Paris, Berlin, and other European capitals have their Academies of Sciences, where the work of the whole nation has a common home, and contributes to the fame of its chief city. In the United States, Boston has its Academy; Philadelphia, its Academy and the American Philosophical Society; Brooklyn, the Brooklyn Institute; and other cities, down to many relatively small ones, have central organizations through which the scientific work done by citizens receives all the credit it is entitled to; but New York, which should have been in the advance of all of these, has had only a few struggling societies devoted to specialties—nothing comprehensive enough to command the allegiance of students of different branches and the attention of the public. To use President Low's words again, "These bodies have revealed at once the strength and the weakness of New York in these directions. They have made clear beyond a doubt the vast resources of the city, both in men and means. But they have also revealed the fact that these resources are as yet insufficiently organized." To this time, by reason of the division among these special societies and the want of a general one, the scientific spirit of the city has lacked intensity of expression. It will be the object of the Scientific Alliance, as President Low believes it has the capacity, to give to New York the agency which it has long needed to develop to the utmost its activities of investigation and experiment in the direction of pure science.

Seven societies, each of which is well known and has done creditable work in its special field, have united in the formation of the Scientific Alliance. They are the New York Academy of Sciences, the Torrey Botanical Club, the New York Microscopical Society, the Linnæan Society of New York, the New York Mineralogical Club, the New York Mathematical Society, and the New York Section of the American Chemical Society.

The advantages which are expected to accrue to these societies and their work from united organization were well presented in the address of Mr. Charles F. Cox. Among them are "the stimulating and re energizing effect which will be wrought in them by the demand made upon them for an increased output of effort for the public good"; the re-enforcement and encouragement they and their members will receive from contact with one another; the saving of work in doing over again what has been already done which will be effected by bringing these laborers in different fields into co-operation and consultation with one another, and enabling them to contribute their several results to a common stock; in short, a union of forces to produce the best results.

The need of endowment for scientific research and publication was presented at the meeting for organization in an address by the Hon. Addison Brown. The existence of such a body as the Alliance, proving its efficiency by its work and extending its influence, may be expected to attract the gifts of liberal-minded capitalists, as do other enterprises for the public good that ac-

complish something. Still another advantage that may be derived from the organization is revealed in Prof. Bolton's idea of its furnishing accommodations in a single building for all the libraries of the societies and for such other libraries of scientific works as may seek a domicile there; each library to be kept distinct, but accessible alike to all the societies, and one supplementing the others. For this and other purposes of the Alliance a building will be necessary, and a plea in behalf of this was made by Prof. N. L. Britton.

Another view of the advantages that may be derived from this movement is afforded by the advances which are being made in all departments of enterprise in which scientific research is the original and most important factor. "The practical men," said the Hon. Addison Brown, basing his remark on the confession to him of an electrical expert who had made several very interesting and important inventions, "do not work at random, but upon the basis of what scientific research and publication have previously put within their grasp." Capitalists and corporations have derived immense wealth and power from the fruits of this work; and yet science, which has furnished them the instruments of their success, has received the most niggardly treatment from them, and has been spurned and scorned by them as unpractical. A society that will serve as a center for its scattered forces and give it a voice by which it can assert itself and emphasize its claim for recognition can not fail to help it greatly in commanding the homage of its debtors.

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### *MORAL EVOLUTION.*

The recent articles of Prof. St. George Mivart on Happiness in Hell, in spite of what must seem to many their fanciful character, may reasonably be regarded as an encouraging sign of the progress the modern world is making in the direction of reasonable views and humane sentiments. Mr. Mivart states at the outset that "not a few persons have abandoned Christianity" on account of the popular doctrine of a hell involving unending torture for untold multitudes of human beings, and that this doctrine now "constitutes the very greatest difficulty for many who desire to obtain a rational religious belief and to accept the Church's teaching." The object which he has in view is to show that the absurd and cruel ideas which have gathered round the conception of hell are no essential or authoritative part of Christian doctrine. Whether he has succeeded in doing so, we must leave to the professional theologians to discuss and, if possible, decide; but, meantime, some of the writer's utterances deserve to be put on record as evidences of the moral evolution which theology itself is undergoing.

"To think," says Prof. Mivart, "that God could punish men however slightly, still less could damn them for all eternity, for anything which they had not full power to avoid, or for any act the nature or consequences of which they did not fully understand, is a doctrine so monstrous and revolting that stark atheism is plainly a preferable belief." The writer of these words could evidently not subscribe to the Westminster Confession, nor to the views of those Congregationalists who have lately been so much exercised over the daring theory advanced by some of their brethren that fairly decent heathen may perchance escape hell without any aid from missionaries. A Catholic authority whom Mr. Mivart quotes says that "if there is one thing certain it is this—that no one will ever be punished with the positive punishments of the life to come who has not with full knowledge, complete consciousness, and full consent turned his back upon Almighty God." The same authority further says that "the God

of all justice must, and will, make every allowance for antecedent passion, for blindness, for ignorance, for inadvertence"; and this, Mr. Mivart explains, will apply to that "large proportion of men's actions which can not be freely controlled by them on account of ancestral influences, early associations or intellectual and volitional feebleness." As we read these declarations we begin to find ourselves somewhat at a loss to conceive the kind of person who would really constitute an eligible candidate for the place which Mr. Mivart so far offends ears polite as to mention. However, some do get there, and then they fare according to their deserts. Their great loss consists in being shut out from what theologians describe as "the beatific vision"—that is, from the happiness of heaven; but they have apparently all the means of enjoyment and even of moral improvement open to them which they had on earth, though without hope of ever changing their fundamental state of separation from God.

Waiving all questions as to the reality of the matter which Mr. Mivart discusses, we venture to express the opinion that the view he puts forward is far more favorable to the interests of religion, and much better adapted to produce moral thoughtfulness, than the heretofore current notions, which no amount of sophistical ingenuity can torture into conformity with justice, benevolence, or reason. So far we extend to the distinguished naturalist and, as it would appear, not inexpert theologian our sympathy, and bid him Godspeed.

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The Index to Volumes I to XL of The Popular Science Monthly, announced as in preparation some months ago, has been completed, and up to March 25th about fifty pages had been put in type. It will make nearly three hundred pages, and, as setting the type for such a book is slow work, we must ask a little more patience from the many who have been anxiously inquiring for the volume.

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## LITERARY NOTICES.

A Handbook of Pathological Anatomy and Histology. With an Introductory Section on Post-mortem Examinations and the Methods of Preserving and Examining Diseased Tissues. By Francis Delafield, M. D., LL. D., and T. Mitchell Prudden, M. D. Fourth edition. New York: William Wood & Co. 1892. Pp. xvii + 3 to 715.

The fourth edition of this standard work has an increase of more than one hundred pages of text, with the addition of seventy-six engravings, while many portions of the book have been rewritten, so that it may include the principal discoveries that have been made in pathology since the publication of the third edition in 1889.

In the section on the methods of preparing pathological specimens for study there has been added a description of the phloroglucin method of decalcifying bone, which is one of the best that can be used, and there is also a description of the satisfactory method of hardening tissues by Lang's corrosive-sublimate solution.

The chapter on the composition and structure of the blood has received important additions in the description of oligocythæmia and of the determination of the presence of the micro, macro, and poikilocytes, as well as a description of the polynuclear neutrophile and eosinophile leucocytes and lymphocytes; and there is a section on the methods of examination necessary to study these various forms.

One of the most important additions to the volume is the section on hypertrophy, hyperplasia, regeneration, and metaplasia; the authors calling attention to the pathological importance of a knowledge of caryocinesis, because a recognition of mitotic figures may permit a decision regarding the particular cells involved in the formation of new tissue.

The chapter on inflammation has been practically rewritten and rearranged, the subjects of tubercular and syphilitic inflammations being now considered under the sections relating to the diseases producing them.

The chapter on animal parasites contains a reference to the *Amœba coli* and its relation to dysentery, and also brief reference to the presence of coccidia in certain epithelial growths. The chapter on vegetable parasites contains reference to ptomaines, toxins, and toxalbumins, as well as an excellent summary of the important question of immunity, though the authors do not commit themselves to any doctrine regarding that subject.

The subject of infectious diseases induced by the pyogenic bacteria has been rearranged and placed as one of the earlier chapters in the work, which seems to us to be an excellent plan. An illustration of the caution displayed by the authors is shown in the section on lupus, in which reference is made to the fact that, while that disease is a form of tubercular inflammation, it is not unlikely that in the clinical group of diseases called lupus there may be lesions that are not caused by the tubercle bacillus, a point that must be decided by more exact bacterial studies. This same caution is shown in accepting the bacillus described by Lustgarten as the cause of syphilitic inflammation.

The skepticism expressed in the former edition regarding the causative relationship of Löffler's *Bacillus diphtheriæ* to diphtheria, has been supplanted by a frank acceptance of that organism, the first sentence in the section on diphtheria defining that as an acute infectious disease caused by the *Bacillus diphtheriæ*.

New sections on rhinoscleroma, tetanus, influenza, smallpox, scarlatina, measles, and actinomycosis, and descriptions of the *Bacillus œdematis maligni*, *Bacillus pneumoniæ*, and *Bacillus coli communis* have been added.

The chapter on tumors contains a reference to the structures that have been found in and between the cells of tumors, "*inclusions*" that the authors consider to be invaginated epithelial or other cells, or cell nuclei that have undergone various degenerative metamorphoses, fragmentation, etc. They state that some of the cell inclusions in carcinoma may be coccidia or allied organisms; but while not asserting that tumors can not be caused by parasites, they do not believe that adequate ground exists for believing that they are so caused, because the transplantation of tumors from one species of animal to another has almost uniformly failed, while it has been impossible to cultivate either directly or by inoculation any constant organisms from these morbid growths. This matter is one that is attracting the attention of pathologists in several countries, and the more thorough study of the subject of the etiology of cancer will probably determine the status of the coccidia in relation thereto.

The section on chronic arteritis has been rewritten, the authors believing that the morbid changes in the arteries are the results of a combination of chronic productive inflammation and of degeneration occurring in connective tissue—a point of view that regards the arteries as definite parts of the body, and as likely to become the seat of chronic inflammation as the liver or kidneys.

The subject of colitis is another valuable addition, and the text is enriched by some excellent engravings of the several varieties of pathological conditions that occur in inflammation of the large intestine.

In the section on the organs of generation reference is made to the adenomata that lie on the border between the distinctly benign and the definitely malignant new epithelial tissue growths, attention being called to the fact that the more benign forms are extremely prone to develop, both in structure and malignancy, into carcinomata.

While the substitution of the terms "lymph nodes" and "lymph nodules" for "lymph glands" and "lymph follicles" respectively was recommended in the last edition, the change has been made throughout the text in this volume.

The work is fully abreast of the scientific knowledge of the day, and it will undoubtedly be accorded a popularity similar to what it has received in the past.

The Story of Columbus. By Elizabeth Eggleston Seelye. New York: D. Appleton & Co. Pp. 303. Price, $1.

This volume is the first of a series entitled Delights of History, and a delightful book has been made of it. Beginning with the wonderful journeys of the Polos, and the expeditions sent out by Prince Henry of Portugal, events which may well have fired the imagination of the youthful Columbus, we are brought at length to the gates of Genoa. Here we learn something of the condition of the weavers among whom

the Colombos were numbered. Even the house in which the family lived is pointed out. Then follows the story of Columbus's journey to Portugal, his weary waiting in Spain, his voyages, discoveries, misfortunes, and last days spent in pleading with the unappreciative Ferdinand. The tale is related in very simple but graphic fashion, with many touches of humor, while the varied illustrations constantly keep fresh the flavor of the time. Only those anecdotes are given that come from authentic sources, and the recent labors of Mr. Henry Harrisse and Signor Stalieno have added so largely to the fund that there are enough to make the narrative sufficiently life like. No attempt is made to screen the failings of Columbus —his pursuit of wealth, his curious theories, and the evil which is chargeable to him as an exponent of his time, the establishment of slavery in the New World. On the other hand, these are not enlarged until they obscure his courageous project and unflagging zeal. He still remains "the most conspicuous figure in the history of his age." He crossed the sea of darkness, and we rightly honor him for his great achievement.

The Visible Universe. By J. Ellard Gore, F. R. A. S. London: Crosby Lockwood & Son. New York: Macmillan & Co. Pp. 346. Price, $3.75.

Although astronomers have not yet solved the problem of celestial construction, the author of this volume refrains from adding any new conjecture to the list. He examines critically all the explanations worth serious mention, and this task may well have served to keep him within the dry land of fact. Besides the theoretical discussions, the book contains the latest observations of the position of stars and nebulæ and, so far as known, their motions and chemical composition.

Five principal objections have been brought against the nebular theory; most of these have been well answered by M. Roche. According to M. Wolf, two points are yet undetermined—how large planets were formed from the nebulous mass, and how the equatorial and orbital inclinations were produced. M. Faye, however, finds the fifth objection—the retrograde motion of the satellites of Uranus and Neptune—destructive of Laplace's theory and advances another hypothesis in his work, Sur l'Origine du Monde, with which Mr. Gore agrees. In this he assumes that the earth was formed before the sun, and that its internal heat sufficed for the evaporation of water and for the uniform vegetation that existed for æons of time. Laplace did not explain the origin of the primitive nebula, therefore Dr. Croll considered the hypothesis incomplete and furnished a cause in his impact theory. Two dark bodies endowed with enormous velocity collided in space and produced a perfect nebula!

A contention which promises no settlement is the duration of the sun's heat in past time. Noted physicists allow only twelve millions of years as the maximum period on the gravitation theory. This is insufficient for the geologists, who demand a hundred millions for the denudation of rocks. Dr. Croll's careful estimate is ninety millions; while biologists ask for a still longer period for the evolution of species. Most astronomers concur in the theory of Helmholtz that the heat of the sun is caused by the shrinkage of its mass through gravitation. To this philosopher also is due the vortex-ring idea —that matter consists of whirling portions of the luminiferous ether. This wondrous fluid, supposed to fill interstellar space and act as a medium for the transmission of light, is enormously elastic and wholly unlike matter, since planetary motion is not retarded by it as it would be by the most attenuated gas.

The spectroscope, which has revealed so much of the constitution of the stars, shows also another defect in the nebular theory, unless chemists may come to the rescue. The spectra of various nebulæ give only hydrogen and one other unknown element. If the solar system was evolved from a nebulous mass by condensation, whence the dozen elements of the sun and the sixty-five of our own planet? It has been suggested that all our elements may be further resolved into one original element. In anticipation of its discovery this has been named *protyle*.

Lockyer's hypothesis was that the upper reaches of the atmosphere contained particles of magnesium, manganese, iron, and carbon, and that nebulæ were swarms of meteoritic dust. His observations in regard to

the magnesium flutings are not accepted by other astronomers, and experiments do not confirm his explanation of the aurora. Most puzzling of all astronomical problems perhaps is the arrangement of stars. If we could observe from some other point in the heavens the system might be disclosed to us, or even if we could compute the distance of every star, the design might appear. In all cases, however, the parallaxes are so small that the measurements are exceedingly difficult. The number of visible stars is estimated by the author as seventy millions. Outside of this finite universe there may exist vast systems in space whose light has not yet reached us, or which may be forever hidden, because light itself is extinguished in a separating void.

Some fine photographs of stars and nebulæ accompany the text; an index and notes are also added.

Human Embryology. By Charles Sedgwick Minot. Illustrated. New York: William Wood & Co. 1892. Pp. xxiii + 815.

The appearance of another work on embryology justifies the assertion that was recently made in these columns that there was a growing appreciation of the importance of this subject. The present volume has been expected for some time past, as the announcement was made some years ago that Prof. Minot was engaged in the preparation of a work upon this topic. The ten years' labor that has been directed to making original investigations and to collecting and reviewing the literature of the subject, is presented in this splendid volume that is a worthy representation of American scholarship and research.

On account of the intimate relations between the uterus and the embryo, the author devotes his first chapter to a careful presentation of the anatomy and the histology of the uterus, together with a description of the changes that occur during pregnancy. In the second chapter there is a general outline of human development, in which there are retrogressive and progressive histories of the fœtus and its envelopes.

The author calls attention to the limitation of the term *genoblast* to the sexual elements proper, to the spermatozoön or the egg-cell after maturation, and not to the spermatophore or the egg-cell before maturation. The subjects of spermatozoa, ova, ovulation, and impregnation are described with reference to the latest investigations. The author believes that the ovum draws the spermatozoa toward itself by chemical influence, acting as an attracting stimulus, in a similar manner to the attraction Pfeffer has shown certain chemical substances may have for moving spores; the attractive power of the ovum being annulled or weakened by the formation of the male pronucleus. As a solution of the origin of sexuality the attractive hypothesis is offered that *sexuality is coextensive with life; that in protozoa the male and female are united in each of the conjugating cells, and impregnation is double; and, finally, that in the metazoa the male and female of the cells separate to form genoblasts or true sexual elements, and impregnation is single.*

The author presents a great deal of evidence to support the theory that concrescence is the typical means of forming the primitive streak in the vertebrate, the primitive axis of which is formed by the growing together in the axial line of the future embryo of the two halves of the ectental line.

The origin of the mesoderm, the formation of the cœlom and mesothelium, and the origin of the mesenchyma, are carefully described in connection with a review of the principal theories in regard to the morphological significance of the mesoderm, the author believing that Hatschek's germ-band theory offers the best-founded explanation of the vertebrate mesoderm.

Emphasis is laid on the fact that the splanchnocœle (pleuroperitoneal cavity) is almost, if not quite, from the start divided into a precociously enlarged cervical portion (amnio-cardial vesicles), and a rump portion (abdominal cavity), the boundary between the two portions being marked by the omphalo-mesaraic veins, that run from the area vasculosa into the embryo proper at nearly right angles to the embryonic axis.

The author agrees with Ziegler that the red blood-cells of all vertebrates arise by proliferation of the endothelial lining of the vessels, basing this conclusion upon the facts that in various vertebrates certain parts of the vascular system are at first solid cords of cells, the central portion becoming blood-cells

and the peripheral portion the vascular wall, and in birds the red cells arise from the walls of the venous capillaries of the bony marrow. In other words, the blood-cell is a liberated, specialized endothelial cell.

One of the most interesting and valuable chapters in the volume is that on the germinal area and the embryo and its appendages, in which there is a synopsis of the published descriptions of embryos not over three weeks old; from these it is learned that no human ovum has been observed to have a primitive streak, which is the first stage of the series formulated by the author. In this stage (twelfth or thirteenth day) the human ovum is a rounded, somewhat flattened sac of three or four millimetres in diameter, bearing an equatorial zone of short, unbranched villi that are probably formed by the ectoderm only; the wall of the sac is ectoderm, whether underlaid by somatic mesoderm or not is uncertain; a mass of cells is attached to the inner wall of the sac, over one of the bare poles of the ovum, constituting the rudiment of the embryo. The second stage is characterized by the appearance of the medullary plate, the third by the appearance of the medullary groove, the fourth by the formation of the heart and medullary canal, the fifth by the development of the first external gill-cleft, the sixth by the appearance of two external gill-clefts, the seventh by the appearance of three gill-clefts, and the eighth by the appearance of four external gill-clefts.

The fourth part of the work includes descriptions of the chorion, the amnion and proamnion, the yolk-sac, allantois, and umbilical cord, and the placenta.

The final portion of the volume is devoted to chapters on the growth and development of the various organic systems of the fœtus.

Each section and chapter aims to present a comprehensive review of the literature regarding the subject therein considered, the author stating the reasons for accepting certain theories in preference to others. One blemish in the volume is the free use of German embryological terms. The author's devotion to German has often led him to use, also, forms of expression that, while correct in German, are faulty English. This is, however, a minor and remediable fault in what is a most excellent book.



Pioneers of Science. By Oliver Lodge, F. R. S. London: Macmillan & Co., 1893. Pp. 404. Price, $2.50.

This work consists of a course of eighteen lectures on the history and progress of astronomical research, with biographical sketches of each pioneer and an examination of their influence on the progress of thought. It is divided into two parts. The first, which is entitled From Dusk to Daylight, contains ten lectures giving a brief outline of the physical science of the ancients, with an interesting account of the progress of astronomy from Thales, 640 B. C., to the death of Newton, 1727 A. D. The second part is called A Couple of Centuries' Progress, and embraces the period of astronomical discovery from the publication of Newton's Principia to the present time.

The author shows considerable power of lucid condensation in his description of the labors of the early astronomical scientists, and while giving a brief history of their discoveries—notably those of Archimedes, Ptolemy, and Roger Bacon—he brings us at a bound over the void of the middle ages to the beginning of the sixteenth century (1543) when Copernicus (Nicolas Copernik) published his famous work, De Revolutionibus Orbium Cœlestium, in which he proved that the earth is a planet like the others, and that it revolves round the sun—thus shattering the accepted Ptolemaic system and revolutionizing all other (speculative and theological) doctrines concerning the form of the earth and the motion of the heavenly bodies.

This period is called by Mr. Lodge "the real dawn of modern science." His sketch of Tycho Brahé is most interestingly written; and in the summaries of facts which preface each lecture will be found some curious coincidences of the dates of the birth and death of the famous philosophers from Copernicus to Newton. While admitting the great labors and immense value to astronomical research of Galileo's discoveries, the author does not class him with Copernicus, Kepler, or Newton; in fact, he says that "Archimedes and Galileo can only be considered in the light of *experimental* philosophers." Lord Bacon, who flourished about the same time as Descartes, is very summarily dismissed; he does not admit him into his list of philosophers, and says: "His (Bacon's) methods are not

those which the experience of mankind has found serviceable; nor are they such as a scientific man would have thought of devising."

Mr. Lodge pays reverent tribute to the genius of Sir Isaac Newton, and claims for him the palm-wreath among all other philosophers—ancient or modern. His treatment of the biographical sketch of Newton and of his discoveries and the preparation of his laws of gravitation, motion, etc., as contained in the Principia, are most interesting as well as valuable.

The second part of the work (eight lectures) is rather condensed. Laplace's mathematical genius is briefly described, while the birth of stellar astronomy and the works of Sir William and Caroline Herschel are excellently portrayed. The volume closes with chapters upon Comets and Meteors, and Tides and Planetary Evolution. It is profusely illustrated.

Hygienic Measures in Relation to Infectious Diseases. By George H. F. Nuttall, M. D., Ph. D. (Göttingen). New York: G. P. Putnam's Sons, 1893. Pp. 112. Price, 75 cents.

This is a very useful little work and should have a place in every home library. There seems to be an almost general ignorance of both the causes of infectious diseases and how to prevent their spread; and Dr. Nuttall has produced this little handbook in a form that is so simple and instructive that even the least scientific reader can, without any difficulty, prepare and use ample means for the disinfection of persons, houses, furniture, etc.—no matter from what cause the infectious material may exist.

The author warns people against using made and patent disinfectants"; for, as he says, "the term disinfection means the *absolute destruction* of infectious material," and "many preparations sold as disinfectants are nothing of the kind," but belong to the anti-septic and deodorant classes. He gives, as the best and most certain methods, those by fire, dry heat, steam, and chemicals, and in a foot-note to the paragraph "Disinfection by Boiling," he quotes Flügge most instructively: "The ordinary treatment to which soiled linen and clothes are subjected in the laundry (one half-hour's boiling) would be quite sufficient for their disinfection were it not for the fact that the process of boiling is preceded by the processes of sorting, soaking, and *rinsing in cold water*."

The volume contains practical directions for the treatment of infectious diseases in private houses and other places; and the second part is devoted to excellent "information as to the causes and mode of spreading of certain infectious diseases and the preventive measures that should be resorted to."

Rest and Pain. By the late John Hilton, F. R. S. London and New York: George Bell & Sons. Pp. 514. Price, $2.

This work, which its editor speaks of as "acknowledged to be one of our few surgical classics," has reached its fifth edition in England, and is now offered to medical students and practitioners in America. Its special claim to attention is that it presents certain facts in a different grouping from that of the usual treatises, thus throwing a new light upon the bearing of much that may seem useless or abstruse to the student. It has the two objects of preaching to physicians a let-alone gospel, designed to secure greater reliance upon the work of Nature, and of pointing out how much can be learned in regard to various disorders from the pains that accompany them. The volume consists of a course of lectures delivered by the author as consulting surgeon to Guy's Hospital, under the title, The Therapeutic Influence of Rest and the Diagnostic Value of Pain in Accidents and Surgical Diseases. It deals with injuries and diseases of the brain, spinal column, the joints, the sacro-iliac region, with abscesses, and miscellaneous other disorders. A large number of cases are quoted in this treatise, and the text is illustrated with 105 cuts.

Domestic Science. By James E. Talmage. Salt Lake City: George Q. Cannon & Sons. Pp. 389.

The field of this book embraces the applications of science to the affairs of domestic life—a field concerning which there has always been a great amount of ignorance. The dispelling of this ignorance was one of the tasks that enlisted the efforts of the founder of this magazine, who published his Handbook of Household Science over thirty

years ago. Dr. Talmage's treatise is very like the Handbook as to scope and method, and the author quotes his predecessor frequently in foot-notes. It is divided into four parts, treating respectively of Air and Ventilation with chapters on Heating and Lighting, Water, Food and its Cookery, Cleansing Agents, to the last of which is added Poisons and their Antidotes. In each of these divisions the laws of Nature that especially concern the matters in hand are stated, and the evil effects of disregarding these laws in each case are pointed out. The text is much strengthened by illustrations. The book has been adopted as a text-book for the Territory of Utah, and the present is a second and revised edition prepared for such use. The introduction of this subject into the schools can not fail to do much good.

Introduction to Physiological Psychology. By Dr. Theodor Ziehen. Translated by C. C. Van Liew and Dr. Otto Beyer. New York: Macmillan & Co. Pp. 284. Price, $1.50.

The recent introduction of the inductive and evolutionary mode of treatment into the field of mental science has brought forth abundant fruit where, for a long time, barren speculation had held sway. Psychology, or a division of it at least, has become a natural science, and knowledge of mental processes has been rapidly extended in consequence. Especially has this work gone on actively in Germany, and the facts obtained have received two distinct interpretations—the one held by Wundt and his school, the other by Münsterberg and Ziehen. Only one treatise on physiological psychology — the large work by Prof. Ladd, of Yale—has appeared in English, hence the translators have thought that such a small introductory compendium as the present volume would be desirable. The work originated in a series of lectures that Dr. Ziehen has delivered at the University of Jena for several years. It has been the aim of the author throughout to develop all explanations from physical or physiological data, and to account for the presence of certain functions by an application of the laws of evolution. The doctrines that he presents differ essentially from Wundt's theory and conform closely to the English psychology of association. By introducing an especial auxiliary function, the so-called apperception, for the explanation of certain psychical processes, Wundt evades numerous difficulties in demonstration. This book is intended to show that such an "auxiliary function" is superfluous, and that all psychological phenomena can be explained without it.

Chemical Lecture Experiments. By G. S. Newth, F. I. C. London and New York: Longmans, Green & Co. 1892. Pp. 323. Price, $3.

This book is of some importance to chemical lecturers and teachers, as well as being a valuable assistance to the chemical student. It consists of six hundred and thirty-two illustrated experiments, which are given with remarkable lucidity, the author claiming that "no account of any experiment has been introduced upon the authority solely of any verbal or printed description, but every experiment has been the subject of his own personal investigation, and illustrated by woodcuts from original drawings." It is arranged in such a manner that students may learn from it the methods of preparation and most of the important properties of the non-metallic elements and their more common compounds. As a companion to the lectures which he may attend, the chemical student will find fully described in this book most, if not all, of the experiments he is likely to see performed upon the lecture table, thereby relieving him from the necessity of laboriously noting the apparatus, etc., used by the demonstrator. Many of the experiments are novel and interesting, and the tables which form the appendix will be found to contain important information for which books of reference are usually needed.

An overgrown volume of nearly fifteen hundred pages on *Education in the Industrial and Fine Arts in the United States* comes to us from the Bureau of Education. This is only the second part of a special report by *Isaac Edwards Clarke*, and the editor states that most of the matter intended for this volume has been relegated to a third part. There is first an Introduction of over a hundred pages, in which the editor devotes several of the early pages to telling how his first part has been praised. Soon after this come three

tributes to deceased educators, which would be better published elsewhere. A little farther on the editor has a tilt with Prof. C. M. Woodward, and near the end several defenses of the public schools, having no bearing on the proper subject of the report, are brought in. The report proper consists of five hundred pages of well-digested material, being mostly accounts of the instruction in industrial art and the use of mechanical tools that has been introduced in various places. This is followed by eight hundred pages of appendixes made up of miscellaneous reports, essays, and addresses, parts of which are valuable, other parts pleasant but vague, and much of the whole merely duplicating other matter in the volume. There is a great deal of matter in these appendixes that only makes the volume clumsy and impedes the earnest student of pedagogy. Here and there we find poetical quotations or wholly unnecessary lists of names, and in one place a lot of "after-dinner" speeches with the "applause" duly interjected. It is no wonder that the public printer can not get these bulky reports out until they are stale, and that so many copies go unread back to the paper-vat.

A little text-book devoted wholly to mensuration has been prepared by *Alfred J. Pearce*, and is published by Longmans, Green & Co., under the title *Longmans' School Mensuration* (80 cents). It comprises reduction of denominate numbers and the calculation of lengths, areas, and volumes. There are a large number of examples at the end of each section, and several sets of examination papers have been introduced. A simple proof of nearly every rule is given. The diagrams illustrating the various figures and solids are very numerous, and have been carefully prepared.

*The Step-by-Step Primer*, prepared by Mrs. *E. B. Burnz* (Burnz & Co., 24 Clinton Place, New York, 25 cents), embodies a thoroughly scientific mode of teaching reading. The phonetic principle is the basis of its method, and the author does not allow any such host of exceptions and deviations from this principle as often makes what passes for "phonic teaching" into a mongrel practice. The author insists that the letters shall be regarded as standing for spoken sounds, just as definitely as the characters in a piece of music stand for musical sounds. No one can question that this was the intention of the ancient inventors of the alphabet, but the fact is too often lost sight of, especially by teachers of reading. In this primer each letter is made to show what sound it stands for, and the learner has only to combine these several sounds to get the whole word. This is effected by means of the Burnz's Pronouncing Print, the chief feature of which is that when a letter has an irregular sound this sound is indicated by a small subscript letter cast on the shoulder of the type. Webster's diacritics are also made use of, and silent letters are denoted by Leigh's hair-line type. Some Hints on Phonic Teaching are appended to the book. The primer is attractively illustrated and neatly printed.

In a volume of 443 pages, John C. Branner, Ph. D., State Geologist of Arkansas, has issued Vol. III of the *Geological Survey of Arkansas*. This volume concerns "whetstones and the novaculites of Arkansas," and was prepared by *L. S. Griswold*, assistant geologist. The whetstone industry is very exhaustively treated, and the admirable illustrations and maps will be found very useful. The last chapter is devoted to an interesting account of The Fossils of the Novaculite Area, and contains articles by R. R. Gurley, M. D., and Charles S. Prosser, on The Geological Age of the Graptolite Shales of Arkansas and Notes on Lower Carboniferous Plants. (Little Rock, Ark., Press Printing Company, 1892.)

Under the title *Coal Pits and Pitmen*, *R. Nelson Boyd*, M. Inst. C. E., has recast his publication *Coal Mines Inspection ; its History and Results*. In this volume of 256 pages the author reviews the conditions of the mining operatives of Great Britain, and gives in somewhat of detail a history of the legislation for the prevention of the employment of women and children in coal mines. Considerable space is devoted to an examination of the causes of explosions in mines, and there are some excellent suggestions as to required legislation in the direction of increased inspection. In treating of the development of the coal industry in England the author gives some very interesting facts: for instance, toward the end of the eighteenth century the yearly output was estimated to be ten millions of tons—giving employment to fifty thousand work-people, whereas the

output of coal in 1891 reached the enormous total of one hundred and eighty-five millions of tons—giving employment to about six hundred thousand persons. The book contains some excellent illustrations, and will be read with interest by those who desire to study the social and labor questions. (London: Whittaker & Co. New York agents, Macmillan & Co. 1892.)

Few persons outside those connected with engineering business are aware of the importance of the pattern-maker. In a volume of 180 pages *A Foreman Pattern-maker* has embodied the most useful hints to apprentices and students in technical schools under the title *The Principles of Pattern-making.* The book is fully illustrated with one hundred and one engravings, and includes a useful glossary of the common terms employed both in pattern-making and molding. Considering the size of the volume it is really surprising to find such a fund of useful information upon the fundamental principles of pattern-making condensed into so small a space. The illustrations were nearly all made by the author himself, and are almost self-explanatory. It is published by Whittaker & Co., London. (New York agents, Macmillan & Co. Price, 90 cents.)

*The Microscopical Examination of Potable Water* is a little volume of 160 pages which contains a good deal of useful information concerning the best methods and apparatus necessary for the microscopical and bacteriological examination of water. The author, *George W. Rafter*, devotes considerable space to an explanation of the advantages of filtration by sand over the Parkins cloth method, and gives minute details of several examinations and analyses of the various public water supplies of the country, basing the arguments which follow upon the results of an examination of the Boston Sudbury River Water Supply. The remarks upon the effect of light upon the formation of starch in the algæ are interesting, and he claims that in certain lights the starch remains protoplasmic, and that a low temperature and darkness are unfavorable to the growth of algæ in the water supplies. The book is No. 103 of the Van Nostrand Science Series.

In a volume of 322 pages entitled *Figure Skating, Simple and Combined*, Messrs. *Montagu S. Monier-Williams*, *Winter R. Pidgeon*, and *Arthur Dryden*, the most eminent of British figure skaters, have given an elaborate treatise upon the development of figure skating in England. It is profusely illustrated with cuts and diagrams, and is published by Macmillan & Co., New York ($2.25).

*Leonard Dobbin*, Ph. D., and *James Walker*, Ph. D., D. Sc., have issued a useful handbook of 240 pages entitled *Chemical Theory for Beginners.* It is written with the object of assisting beginners in obtaining an elementary knowledge of the principles upon which modern chemistry is based. The chapters on Elements and Compounds, Chemical Action, Vapor Density, and The Kinetic Molecular Theory are interesting from a standpoint far advanced from the beginner. The use of symbols has been disregarded in this work, so that a very young student in chemistry will have no difficulty in understanding the most intricate examples of chemical compounds, etc., which are given. The kinetic theory of gases, as discovered by Clerk Maxwell and Clausius, is very simply demonstrated. The book is published by Macmillan & Co., of London and New York (70 cents).

In a volume of 978 pages the Interstate Commerce Commission has issued its *Third Annual Report on the Statistics of Railways in the United States.* It is a comprehensive tabulation of the classification, mileage, earnings, expenditures, and capital of the various railway systems of the country. In the reading matter which prefaces the voluminous and interesting statistics there is a complaint that the statistical data procurable from the monthly reports of the different railway corporations is of little value to publicists and economists; and it is claimed that the present system of bookkeeping in vogue among the accountants of the different roads "leads inevitably to an erroneous balance-sheet." The remarks upon and the statistics of the enormous increase of mileage will be read with interest by economists, and the fact that this increase is proportionately far greater in the Southern States will be a surprise to those who have not carefully observed the industrial progress of that section of the country.

D. C. Heath & Co., Boston, have issued a new publication entitled *The Complete*

*Musical Reader*, which is designed for "high and normal schools, academies, and seminaries." It is compiled and edited by *Charles E. Whiting*, and is really a most useful addition to the repertoire of school music books. The first forty-eight pages are devoted to musical notation, embracing exercises and solfeggios of a very educational type. The collection of two, three, and four part songs is excellent; but in the two latter sections some of the selections are rather difficult for beginners. Among the three-part songs is a novel arrangement of a solo with voice (duet) accompaniment—a style of voice culture that will probably become more general. The hymn tunes are easy, and will be found useful by teachers in connection with the rudimentary exercises and solfeggios. It contains 224 pages, and is published at 85 cents.

Recognizing the great agricultural depression existing in England and the apparent impossibility of farmers being able to prosper from the cultivation of grain crops, *J. Cheal*, F. R. H. S., suggests that cultivators of the land should consider what other means might be adopted in the way of yielding crops that would give more satisfactory returns. In his book entitled *Practical Fruit Culture*, which is published by George Bell and Sons, London, 1892, he advocates that, taking into consideration the "enormous quantities of fruit" imported into England for consumption there, fruit culture would be one of the best if not the most important means toward a renewed agricultural prosperity. The volume contains some excellent information upon the fruits most adaptable to the climate of Great Britain, and instructive hints as to their planting, cultivation, etc. (194 pages; price, 75 cents).

In a volume of 241 pages, C. W. Bardeen, of Syracuse, N. Y., has published three series of songs "for schools," which contain over three hundred selections. The first series is entitled *The Song Budget*, and is devoted to nursery rhymes and songs for young children; the second is called *The Song Century*, embracing some of the most popular standard songs; and the third, *The Song Patriot*, gives examples of patriotic songs, war songs, and national hymns. It is a useful cheap edition of song music, but the compiler has made some rather unfortunate omissions in neglecting to give the composers' names, while in at least one important instance wrong authorship is claimed. This, however, does not affect the arrangement of the music, which is excellent (price, 50 cents).

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Bedell, Frederick, and Crehore, Albert Cushing. Alternating Currents. New York: The W. J. Johnston Co., Limited. Pp. 325.

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Bishop, Louis F. A New Measurement in the Study of Fever. Pp. 5.

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# POPULAR MISCELLANY.

**Number of Glacial Periods.**—An article by Prof. George F. Wright, in the American Journal of Science, is devoted chiefly to showing that certain points of evidence relied upon by those who believe that the "Glacial epoch" consisted of two periods of glaciation of similar extent separated by a long interglacial epoch, are insufficient to afford a basis for such a conclusion. Furthermore, the author adds to this: "As bearing against the duality of the Glacial period, it may be urged with great force that it is improbable that two periods should so nearly duplicate one another as these two are supposed to have done. To those who maintain the sufficiency of Croll's astronomical cause, however, this is rather an argument in favor. But, on the other hand, that cause would also demand a long succession of periods during all the geological ages, and of these we lack sufficient proof; while it would throw the two periods which Prof. Chamberlin recognizes back much farther than the facts will admit. It must be said, however, that it is not wholly out of analogy with known earth movements to suppose that

there has been in connection with the Glacial period a succession of oscillations of the earth's crust nearly duplicating one another. Such oscillations seem to have occurred in various geological ages, as, for instance, during the coal period, when the successive coal beds were formed. And, indeed, much can be said in favor of the view that such an oscillation when once begun would perpetuate itself. . . . But our knowledge of these matters is too vague to reason of it with any confidence, as is that also of the other causes which have been suggested for the production of the phenomena of the period. In conclusion, it is sufficient to remark that our present state of knowledge on the subject seems so imperfect that it is not conducive to success in investigation to hold any theory as to the unity or duality of the period with great positiveness. Overconfidence on this point at the present time is likely to blind the eyes of the investigator, and to hinder progress both in the collection and in the interpretation of the multitudinous and complicated facts which everywhere invite our close attention."

**Preservation of Leaves as Fossils.**—In a paper on the Preservation of Plants as Fossils, Mr. Joseph F. James, of Cincinnati, names as one of the requisites to secure the preservation of any plant, that it must be in a position to be almost immediately covered by some material. A leaf or branch falling to the ground and likely to be exposed to the elements has a poor prospect of being preserved. But if it fall into the water and, sinking to the bottom of a lake or swamp or morass, be covered by mud or sand; or if it lie on the seashore and be covered by sand brought in with the tide, it may at least leave its mark. Or it may, through certain chemical properties it possesses, so act upon the stone on which it lies as to be preserved, not in actual substance, but as an intaglio. The author was impressed with the possibilities of the last process while walking along the street in the rain and looking at the fallen leaves on the pavements. He first noticed numerous irregular, discolored patches on the stone slabs. Looking more closely, he says: "I found that these discolorations had been caused by the leaves, which had left their impress on the stone. In many cases this impression was so distinct that there was no difficulty in recognizing the species. The leaves were those of the soft maple, one or two species of oak, tulip tree, and sycamore. There is here a possibility of the preservation of the remains of plants, or, at all events, of their impress upon stone, had it occurred under more favorable circumstances. But on a pavement, where people were passing constantly, the impressions were worn off and soon disappeared. The rain, however, did not seem to wash them away, so they were something more than mere surface markings." A similar phenomenon was observed and described in 1858 by Mr. Charles Peach in a paper on the Nature Printing of Sea-weeds, on the rocks of one of the Orkney Islands in Scotland.

**Breath Figures.**—Some interesting experiments are described by W. B. Croft in the production of "breath figures"—or latent impressions on contact of objects with glass and electrifying, which are made visible by breathing upon them. While there appears to be no limit to the durability of these figures if they are carefully protected, they usually become obscured by dust gathering on them after being often breathed upon. But certain changes or developments take place after the lapse of some weeks or months. In coin pictures, the object is near to the glass, but not in contact with it; for in the best specimens the rim of the coin keeps the inner part clear of the surface. Even if a coin only rest for a while on glass, an outline of the disk and sometimes faint traces of the inner detail will be produced when the spot is breathed upon. An examination paper, printed on one side, put between two plates of glass and left for ten hours, either in the dark or the daylight, will leave a perfect breath impression of the print, both on the glass that lay against the print, and on that which faced the blank side of the paper. Sometimes both impressions are white, and sometimes they are both black; or one may be part white and part black, or may even change while being examined. The impressions were very easy to produce during a sharp frost with east winds early in March, 1890. The following experiments easily succeed at any time: Stars and crosses of paper are placed for a few hours beneath a plate of

glass; clear white breath figures of the device will appear. A piece of paper is folded several times each way to form small squares, then spread out and placed under glass; the raised lines of the folds produce white breath traces, and in one instance a letter-weight that was above left a latent mark of its circular rim. Some writing made on paper with ordinary ink and well dried, left a very lasting white breath image after a few hours' contact. Plates of glass lying for a few hours on a table cover worked with silk acquired strong white figures from the silk. Two cases have been reported where blinds with embossed letters left a latent image on the window near which they lay; it was revealed in misty weather, and had not been removed by washing. A glass which has lain above a picture for several years, but has been kept from contact by the mount, will often show on its inner side an outline of the picture, always visible without breath. The words white and black in the descriptions of the impressions relate to the adherence of the breath to the reliefs (white) or its non-adherence (black). The exact cause of the phenomenon is not known, but is supposed to lie in some of the unknown regions of molecular agency.

**Exclusive Communities.**—The number of ants dwelling together in a community, according to Sir John Lubbock, is sometimes as great as five hundred thousand. They are always friendly toward each other, no quarrel ever having been observed between two ants, members of the same community. They are, however, very exclusive, and regard an immigrant with horror. When an ant of the same species belonging to another nest appears among them, he is promptly taken by the leg or antenna and put out. It would naturally be surmised that this distinction was made by means of some communication. To test whether they could recognize each other without signs, attempts were made to render them insensible, first by chloroform and afterward by whisky. "None of the ants would voluntarily degrade themselves by getting drunk." Finally, fifty ants were taken, twenty-five from one community and twenty-five from another, and dipped into whisky until intoxicated. They were then appropriately marked with a spot of paint and placed on a table where the ants from one nest were feeding. The sober ones noticed the drunkards and seemed much perplexed. At length they took the interlopers to the edge of the moat surrounding the table and dropped each one into the water. Their comrades, however, they carried home and placed in the nest, where they slept off the effects of the liquor.

**The Comma Bacillus, Cholera, and Sanitation.**—Experiments by Prof. von Pettenkofer and Prof. Emmerich, in which they swallowed fresh cultures of comma bacillus upon empty, neutralized stomachs, show conclusively to von Pettenkofer that the comma bacillus, during its sojourn in the intestine, does not produce the specific poison that causes Asiatic cholera. This agrees with the results obtained by Bouchard, who was able to induce the symptoms of cholera in rabbits by giving them the excreta of human cholera patients, but not by giving them pure cultures of comma bacilli or their metabolic products. While he does not deny that the comma bacillus has some etiological importance, von Pettenkofer can not believe it is the $x$ which, without the assistance of $y$, can cause epidemics of cholera; and he reiterates his well-known views on the influence of the soil, especially in connection with the rainfall. His practical teaching may be summarized in the formula that it is the $y$—that is, the local physical and sanitary conditions—that must be attended to; each place must, in short, be made cholera-proof by sanitation.

**Children and Flowers.**—In a paper read before the Society of American Florists, on training children to love and cultivate flowers, Mr. Robert Farquhar argued that we could either stifle or strengthen the love of Nature which is planted in every young heart. If we encourage and cultivate this love the mind of the growing child will be opened to the beauties of Nature, and we shall in this way provide for it a means of healthy exercise out of doors and a source of delightful recreation all through life. Children should have gardens of their own to care for, and they should be instructed in garden practice. They should be allowed to sow the seed and care for the plants themselves, although they should be directed in all these operations.

Florists who do business in villages and towns enjoy opportunities for doing effective work among children by explaining to their young visitors the methods of propagation. The claims of children should never be forgotten in making up the lists of premiums for agricultural and horticultural fairs. Prizes should be given for plants grown by them and for bouquets and collections of wild flowers made by them. Village improvement societies are doing excellent work in many sections. Some have distributed seeds and plants to the school children with most satisfactory results.

**African Pluck.**—Mr. Alfred Coode Hore, in his Eleven Years in Central Africa, speaks well of the tribes of the Tanganyika region, which he finds are peaceable and industrious for the most part, but turbulent and aggressive when they have learned to dread molestation by strangers. "It seems hard," he says, "that a man should be called lazy because he has ample leisure between his busy times; who has made with his own hands from Nature's raw materials his house, his axe, hoe, and spear, his clothing and ornaments, his furniture and corn-mill, and all that he has, and who, though liable often in a lifetime to have to commence that whole process over again, has the energy and enterprise to do so. Too often have the same people been called savage and bloodthirsty who, through all experience and by all their traditions regarding armed strangers as enemies, defend themselves and their own with the desperate energy which, as displayed by our own ancestral relations, we term patriotism and courage."

**Impurities in Ice.**—The once popular theory that water is purified by freezing is, as Mr. Charles Platt shows in Science, not in accordance with facts. While water in its crystalline state should theoretically be nearly pure, still, owing to its formation in needle-like crystals, considerable foreign matter present in the water in suspension may be and is mechanically held within the mass. Another view, that in the freezing of still water a certain concentration of some species of bacteria on the surface of the water may take place, and the first inch of ice may contain these in increased numbers as compared with a sample of water from the same lake, may be well founded, but it is not yet proved that these bacteria have an increased or any vital activity. But when the ice is melted and the temperature of the water is considerably raised, "then we have another problem, that of possible decomposition and organic change in those organisms that may induce results equal to and exceeding those of the bacteria themselves." Disease has undoubtedly, Mr. Platt affirms, been produced by the use of ice from impure sources, and this, too, when mere analysis of the ice in comparison with water standards would not condemn it. But the standards in the analysis of ice must be higher than in that of water. The Massachusetts Board of Health has pointed out that it is not the number of bacteria alone that is to be considered, but their kind, and insists that no water supply that is not fit for drinking purposes should be used as a supply for ice. This is done when ice is gathered from stagnant ponds and sluggish canals that receive the drainage from various sources. Snow ice and ice that has been formed by flooding ice fields with surface water are very liable to be contaminated. In making artificial ice it is customary to use the entire contents of the water tanks. In that case the impurities, repelled at first by the ice forming at the sides of the vessels, are driven to the center and there concentrated, to be at last included in the freezing of the entire mass.

**Protection of Orchards against Frost.**—According to Charles Howard Shinn, in Garden and Forest, experiments are carried on on a practical scale for the protection of fruit against frost in the orange groves at Riverside, Cal. In some winters the temperature falls so low that the oranges are destroyed or injured. As a remedy the cultivators are using appliances for warming the orchards on a large scale. Their experiments show that the temperature can be raised from four to ten degrees by the use of fires. The moment the thermometer falls to the danger point electric bells can be rung and tanks of crude petroleum lighted. One man has fitted up an eighty-acre orchard at a cost of $10,000 or $12,000. He claims that his grove is absolutely protected, and that the running expense will be very little. Other

growers use coal-oil cans filled with kindling wood and coal and placed in the orchard at the rate of from eight to twenty-five per acre. Some provide themselves with two-gallon iron kettles and use reduced petroleum. Ten dollars per acre will pay for the plant and the expense of one night's burning. Horticulturists in other citrus colonies are following in the track of Riverside and preparing for future "cold snaps."

**Curious Fauna of La Plata.**—A curious medley of animal life is described by Mr. W. H. Hudson as existing in the pampas region of La Plata: A poisonous toad which kills horses; the wrestler frog, which suddenly pinches its enemy with its fore legs and then runs away; a large, venomous, man-chasing spider, which pursues men on foot and on horseback; dragon flies, a single individual of which will cause clouds of gnats, mosquitoes, and sand flies to disappear in an instant; and an opossum, fully adapted to life in trees, which yet lives in a desert destitute of trees, and when brought to a tree, which it may never have seen before, will clasp it and climb it with all the agility of its forest-dwelling relatives of North America.

**Manufacture of Fans.**—The manufacture of fans is chiefly carried on now in France, Spain, China, Japan, and India. The fashions are established in France principally at Sainte-Geneviève, Audeville, Corbeil-Cerf, Le Déluge, Coudray, and the vicinity of Beauvais and Méru. At Sainte-Geneviève they work in bone, mother-of-pearl, and ivory; at Le Petit-Fercourt, and Andecourt, in mother-of-pearl and horn; at Le Déluge and Corbeil-Cerf, pear tree, apple tree, and hornbeam wood; at Boirsière, in bone; and at Paris, in shell. The leaf of the fan is generally made and the fan mounted at Paris. Fans have been made in Spain only for some sixty or seventy years, notably at Madrid, Barcelona, Valencia, Malaga, and Cadiz. Most of the Chinese fans are made in Canton and E-moui, but the manufacture is generally diffused through the country, for the fan is a part of the national costume. Every Chinese of good social standing holds a fan during visits of ceremony, and the custom of writing on fans is spread throughout the empire. The principal centers of production in Japan are the cities of Osaka, Kioto, and Nagoya. In that country the fan is a part of the costume of both sexes, and is to be seen in the hand of the soldier as well as in that of the monk. When a gentleman gives alms to a beggar, he often puts the coin upon his fan; and salutes are made by waving the fan as they are in Europe by tipping the hat. There are also fan factories in some other countries. Lace fans are made at Brussels and De Grammont, in Belgium; fans of braided straw, at Fiesole and Vicenza in Italy; and fan-standards of braided grass and cloth embroidered with gold and silver, in Tunis and Morocco; but France holds the first place in the manufacture of luxurious, and China in that of cheap, fans.

**Origin of "Hot Waves."**—A theory is published by Prof. F. Hawn, of Leavenworth, Kan., that our southwest winds are tropical currents, which rise to great elevations in the upper atmosphere, and then flow north and reach the ground again in latitude 34°, bringing subtropical heat. As other results of his theory he concludes that the close atmospheric relations between the upper and lower currents attest their common origin; that the atmospheric temperature is incidentally if not perpetually higher in the upper than on the lower levels; that these relatively higher thermal conditions of the upper atmosphere control the lower atmosphere in the spring and summer, and indidentally in the winter; that the hot waves of the Northwest have their origin in a superheated upper atmosphere, and are condensed by gravitation in their descent to the surface, evolving heat in a ratio inverse to the humidity; and that the *foehn* winds (hot waves), with their resultant temperatures of more than 100° in the temperate seasons and from 65° to 73° in the winter, are not local west of the eighty-eighth meridian, but at intervals simultaneously cover the northern half of the United States.

**Qualities of Slates.**—From experimental studies with roofing slates, Mr. Mansfield Merriman has drawn the conclusions that those with soft ribbons are of an inferior quality and should not be used in good work; the stronger the slate the greater are its tough-

ness and softness and the less its porosity and corrodibility; softness or liability to abrasion does not indicate inferiority, but is an indication of strength and good weathering qualities. The strongest slate stands highest in weathering qualities, so that a flexural test affords an excellent index of all its properties, particularly if the ultimate deflection and the manner of rupture be noted. The strongest and best slate has the highest percentage of silicates of iron and aluminum, but is not necessarily the lowest in carbonates of lime and magnesia. Chemical analyses give only imperfect conclusions regarding the weathering qualities of slate, and they do not satisfactorily explain the physical properties. The soft roofing slates weigh about one hundred and seventy-three pounds per cubic foot, and the best qualities have a modulus of rupture of from seven thousand to ten thousand pounds per square inch. The test of a slate by balancing it, striking it, and observing its ring is a good one, but is not susceptible of quantitative expression.

**Pasteur's Seventieth Birthday.**—The seventieth birthday of Louis Pasteur was imposingly celebrated December 27th, in the presence of eminent men of science and statesmen of different countries. The first address was made by the French Minister of Public Instruction, who spoke of the occasion as the "festival of France and of mankind." Addressing M. Pasteur, he said that while his work could be analyzed only by the scientific, the ignorant and the learned alike knew that he had accomplished something great. All his success was due to his unswerving "apostle's faith" in science. Had he devoted himself to pure science, the topmost place would have been his. Happily for himself and for mankind, he deserted that path and henceforth passed his days in inventing antidotes for diseases that had for centuries decimated the animal and human populations. Prof. Joseph Lister acknowledged the obligations of the professors of the healing art to M. Pasteur. Numerous testimonials and offerings of different kinds were presented to M. Pasteur, with a splendid gold medal, the product of an international subscription.

**Origin of the Asteroids.**—A paper on Groups of Asteroids, by Prof. Daniel Kirkwood, illustrates the theory that these bodies were formed by the resolution of nebulous asteroids. When the number of telescopic planets had grown to hundreds, and when the perihelion distance of some of them had become greater by many millions of miles than the aphelion of others, the theory of explosion was necessarily abandoned. But the doctrine of similarity of origin, the author holds, was not so easily disposed of. The original dimensions of nebulous asteroids were probably many times greater than those of the present bodies. The disrupting tendency of the great bodies of the system, especially when resisted only by the slight central attraction of nebulous asteroids, is easily imagined. Such separation, in short, has no improbability whatever. The dismemberment of comets, as is well known, has actually occurred under our own eyes. Why not also the pulling asunder of nebulous planets? The fact that in many cases the motions of asteroids indicate a common origin, affords strong presumptive evidence in favor of the nebular hypothesis. Possibly, indeed, its true form may have differed from that proposed by Laplace. How many primitive, separate nebulæ were contained in our system, and how many of these primitive masses suffered dismemberment while Mars and the then future earth were yet floating in the solar atmosphere, can not now be told. An indefinite number may, however, undoubtedly be traced. "May not similar processes be also indicated in the slow evolution of binary and multiple stars in the sidereal heavens?"

**Early Fans.**—The extreme antiquity of fans is attested by their appearance in ancient Egyptian and Assyrian sculptures, where they have the shape of a semicircle with a long handle attached at the center. They were probably used in worship to protect the offerings and sacred objects against contamination by dust and flies. They were known also in India, where they were perhaps introduced from China. The story of their origin in the latter country runs that the daughter of a powerful mandarin was obliged, on account of the heat, to take off her mask during the feast of lanterns, in violation of the law and convention. She shook it rapidly in front of her face, both to give herself air and by the quick motion to veil her identity as fully as

possible. Other women followed her example, and the fan was invented. The Chinese historians trace the use of the fan in their country back to a contemporary of Rameses II of Egypt; and it is mentioned by a writer of a thousand years before the Christian era. In ancient Grecian life, a eunuch, in one of the tragedies of Euripides, relates how he waved a fan, "according to the Phrygian fashion," before the hair, face, and bosom of the fair Helen. Fans were early adopted by Roman matrons, who had two kinds—the *flabella* of ostrich plumes, and the *labella* of thin woven stuff stretched over a frame. A Roman woman never went out without a slave (*flabellifera*) whose duty it was to fan her. It is not known whether the fan was used in Europe as an article of the feminine toilet between the fall of the Roman Empire and the eleventh century, for it is not mentioned in that relation; but it was certainly used a great deal in the ceremonies of Roman Catholic worship, when the deacons and the acolytes waved it over the altar at mass. This usage Père Bonami assumes to have traced back to the apostles. Fans are represented in manuscripts and on monuments of the twelfth century and inventories of the fourteenth, under different names, but without specification of their use. They seem to have been disused in the church in the thirteenth century, to appear again after the Crusades in the warmer countries—Spain and Italy—as an accessory to woman's dress; but were not seen in France till the sixteenth century, when they were introduced at court by the Italian perfumers who came in the suite of Catherine de Medicis.

**American and African Deserts.**—The most striking contrast between the North American "deserts" and those of North Africa is described by Prof. Johannes Walther, of Berlin, as consisting in the far greater wealth of vegetation which characterizes the former. In every direction the eye is met by the yellow-blossoming halophytæ, silver-gray artemisiæ, and prickly cacti; between the opuntias are found cushions of moss, and at the foot of the hills juniper trees seven feet high with trunks a foot thick. Such are the features of the landscape of the deserts of Utah, where plant-growth has completely disappeared only in those places in which the saline complexion of the soil kills vegetation. The Van Horn deserts in western Texas, and the Gila deserts in California are equally rich in vegetation; the altitude of these deserts above the sea-level makes no important difference. Either the mean rainfall in the American deserts is greater than in those of Africa, or else the flora of the American deserts is better adapted to a dry atmosphere. Although the deserts of the two continents present fundamental differences as regards vegetation, there is a surprising similarity between them as regards certain important and characteristic desert phenomena, especially with respect to the topography of the country. There is the prevalence of plains, with mountains rising from them like islands, with no intervening heaps of *débris* passing from the plains to the steep mountain slopes. This phenomenon is the more striking, as there are no rubbish deltas, even at the outlet of valleys a thousand feet deep. Another feature common to both is the large number of isolated "island" mountains and of amphitheatre formations in the valleys; also the intensive effect of insolation, which splits the rocks and flints, and disintegrates the granite into rubbish. The denuding influence of the wind is visible not only in the characteristics of the surface forms just mentioned, which differ in important points from erosion forms, but it can be directly observed in the mighty dust-storms which rush through the desert. In view of such agreement of important and incidental geological phenomena in regions so remote from each other, the phenomenon of desert formation must be considered to be a telluric process which runs its course according to law, just as the glacial phenomena of the polar zone or cumulative disintegration in the tropics.

**Wind Effects.**—In a paper on The Wind as a Factor in Geology, published in the Engineer's Magazine, Mr. George P. Merrill, after mentioning several familiar examples of the formation of dunes in Europe, passes to the account of similar phenomena in the United States. In May, 1889, a dust-storm occurred in Dakota during which the soil was torn up to a depth of four or five inches and scattered in all directions; while drifts

of sand were formed, several feet deep in favorable places, packed as snow-drifts are packed by a blizzard. In parts of the Western plains the fine, loose sand has been blown away at times, leaving every pebble and large bowlder standing out in bold relief. The loose material often gathers in the form of drifts or dunes, which travel across the country with frequent changes of outline. A few miles north of Winnemucca Lake, in western Nevada, is a belt of these drifting sand hills, described by the geologist Russell as some seventy-five feet in thickness and about forty miles in length by eight miles in breadth. Another range of sand dunes, at least twenty miles long, and forming hills some two or three hundred feet high, is on the eastern end of Alkali Lake in the same State. Dunes of equal height have been formed on the eastern shore of Lake Michigan, and at Grand Haven and Sleeping Bear have drifted over the woodlands, so as to leave only the dead tops of trees exposed. The erosive power of these drifting sands is often an important agent in wearing away the rocks upon which they strike. Carried along by the force of the winds, they work effectively in undermining cliffs, scouring down mountain passes, and giving curious and fantastic forms to prominent rocks.

**The Whistled Language of the Canary Islands.**—As a result of his studies of the whistled language of Gomera, in the Canary Islands, M. J. Lajard affirms that it is not a special idiom or a whistle which tries to imitate the Spanish language; but it is the Spanish language strengthened by the aid of whistling. "The Gomerian, while he is speaking, puts one, two, or four fingers in his mouth, as we sometimes see done in the street in order to make shrill sounds, and at the same time he whistles with force. There results a mixture of words and whistle, unintelligible to ears not accustomed to it, but in which can be distinguished the words of the language. . . . The whistling, then, is only an artifice employed to carry to a distance the sound of the voice, to the detriment of its distinctness and tone-quality. This last inconvenience is so great that up to this time travelers have been unable to understand the whistled language. To be able to understand it, you must know how to whistle yourself." It is, however, very limited in its compass, and whistled conversations are of short duration. It exists in other of the Canary Islands than in Gomera, and there is reason for believing that it was formerly more widespread and more prevalent than now. Rudiments of a whistled language, the mechanism of which is like that of the Canaries, exist even in Paris; it is employed by butchers and by thieves.

**What constitutes a Polluted Water.**—A water is said to be polluted, according to Prof. von Pettenkofer, when it is no longer clear and inodorous, when fishes and plants perish in it, and when it contains more organic matter and less oxygen than are to be found in the unpolluted portions of the flow of the stream. Such contamination is essentially different from the transient turbidity due to heavy rains or to melting snow. Still, even the permanent pollutions disappear in the further course of the river bed, by deposition and other agencies. Here the rapidity of the stream and the quantity of the water exert a preponderating effect. The most formidable impurities are supposed to consist of the putrescent refuse which flows out of sewers of cities, and quickly produces an offensive odor at the places where it accumulates. Prof. von Pettenkofer has for many years given his attention to the question of the extent to which rivers are polluted by such agencies, and has had researches conducted by his pupils. But nothing has hitherto altered the opinion which he expressed long ago, that sewage may be safely permitted to flow into a river if its volume is not more than one fifteenth that of the river water, and its rate of flow is decidedly greater than that of the current. Taking the city of Munich, which has 280,000 inhabitants, he computes the pollution of the Isar by its sewage as amounting to only $\frac{1}{1000000}$ of the discharge of the river—a pollution so inconsiderable that it can not be detected by the eye when a corresponding mixture is made up experimentally. But it is also not permanent, for at Ismaning, seven kilometres below Munich, the sewage influx is no longer to be detected; and at Freising, thirty-three kilometres below, the chemical and bacteriological

tests show that it has lost nearly all its power of pollution. Thus, the number of 198,000 bacteria per cubic centimetre found by Praus-nitz at the mouth of the Munich sewer was reduced at Ismaning to 15,231, and at Freising to 3,602. A similar result was obtained by Frankel with the water of the Spree at and below Berlin. The mere number of bacteria found has, however, no sanitary significance, since these particular microbes are mostly harmless, and in fact destroy the pathogenic microbes in the struggle for existence. The purifying action of rivers is ascribed by von Pettenkofer to the oxygen dissolved in the water in a free state or separated from organisms. In the latter respect the green algæ and even non-chlorophyllic plants come prominently into consideration. This vegetation should be preserved; but it may be destroyed by a too great concentration of the water to be purified; and to prevent this, industrial waste waters which destroy vegetation must be kept out till they have been purified.

**Bacteriological Processes against Disease.**—According to a summary in the Saturday Review, attempts by bacteriological processes to remove from the human system the germs of infectious disease have been made by six different methods. The first is by Pasteur's preventive inoculation, in which a minute quantity of an attenuated culture of the virus is administered to produce a light attack of the disease. The second is M. Pasteur's method in rabies, in which a mitigated virus is injected into a person already attacked with the disease, to overtake it. The third is the employment of the virus of a comparatively mild disease to protect against a more severe one, as in vaccination for smallpox. Next in order is the destruction of the disease-producing bacteria by the administration of antiseptics or bactericides. A fifth method is the re-enforcement of natural means possessed by our systems for combating disease germs: by re-enforcing the leucocytes or white blood-corpuscles, which destroy bacteria, by means of the injection of the blood of animals insusceptible to the disease; by raising or lowering the temperature of the body of the patient; by alterations of diet, climate, or surroundings; or by injection of phagocyte invigorators. The sixth method is by the injection of the "tox-albumens" formed by the bacteria growing in artificial cultures, as is done in Koch's method for tuberculosis. That these methods have not proved entirely satisfactory, and bacteriological treatment is now apparently at a standstill, is not due, it is thought, to any innate defect in the system, but to some technical detail. "When the ingenuity of man has arrived at the point of being able to prove absolutely that organisms, completely invisible to all but the highest magnifying powers attainable, cause each its particular infectious disease; when these tiny things may be made to grow like plants in a garden, separately and in order; when we can keep rows of tubes each with its deadly contents on our laboratory shelves, or in our incubators, like druggists' bottles of inert powders or crystals—surely we shall not stop at this stage in our control over this 'world of the infinitely little.'"

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## NOTES.

A clarification of muddy liquids and partial separation of micro-organisms is effected by M. R. Lezé by subjecting the liquid to a rapid rotation. Thus, cider, in turbid fermentation, after being whirled in a turbine wheel, came out clear; and while specimens kept in bottles at 86° soon generated bacteria, the yeast and alcoholic fermentation had all disappeared. This method may be found useful in bacteriological investigation; and in industrial operations, for ridding impure and unhealthy waters of most of the organisms contained in them.

Chemical analysis has been applied by M. Berthelot to the solution of a problem in archæology. Taking a piece of copper found by M. de Sarzee in his explorations of the ruins in Mesopotamia, which was obtained from one of the most ancient sites, he made an exact determination of its composition. It contained no tin or zinc, and only slight traces of lead and arsenic. It had been oxidized throughout, and presented itself as a suboxide or a mixture of protoxide and metallic copper. Hence, while the question can not yet be considered decided, the specimen is a contribution of evidence in favor of the existence of an age of copper.

The physicians of Massachusetts have in recent years noticed a development of malarial disease in Cambridge and the vicinity of Boston and in other towns of the State. The origin of the cases in Cambridge seems, from the investigations thus far made, to be

associated with the excavations of brickyards. The examination of cases in the suburbs of Boston points to the upper waters of certain streams.

A very simple remedy for the annexation fever now beginning to prevail in Canada and the exodus to this country which is in full flow, is proposed by Mr. Allen Pringle. It is to "take down the bars" between Canada and her natural market—to cultivate friendly and intimate commercial relations with the United States.

A patented substance called aluminoferric is prepared by English manufacturers, to promote the precipitation of sewage. It is used solid, in slabs twenty-one inches long by ten inches wide and four inches thick, which are placed in a cage fixed in the flow of the sewage, or in solution. The "sludge" is deposited, to be separately carried off or made into manure, and clear water flows away. The use of this substance has been very successful.

Prof. H. Carrington Bolton has been elected President of the New York Academy of Sciences.

The Department of Ethnology and Archæology of the Columbian Exposition intends to provide as complete an anthropological library as possible, by aid of which students and educators may be enabled to become acquainted with the mass of literature on the subject. All authors, societies, museums, and publishers are invited to contribute from their stores all publications on the various branches of the subject. A complete catalogue of the collection will be published and widely distributed. The library will be conveniently and properly arranged and accessible to students, and full information will be given them respecting the books. At the close of the Exhibition loaned books will be returned, and the rest of the library will be placed in the permanent Memorial Museum of Science which is to be established in Chicago.

It is said that the passage of boats containing naphtha has had the effect of poisoning the waters of the Volga. A great deal of the liquid is transported in badly built wooden barges, with a resultant loss by leakage of about three per cent. Consequently the fish are decreasing rapidly, and have already become extinct in some places where the boats stop. The naphtha likewise kills off the insect life on which the fish feed, by being carried in times of flood to the adjacent meadows and destroying the larvæ there.

The New York branch of the American Folk Lore Society was organized at the house of Mrs. Henry Draper, February 24th, when a constitution was adopted, and officers were elected as follows: President, H. Carrington Bolton; vice-presidents, G. B. Grinnell, R. W. Gilder; treasurer, H. M. Lester; secretary, William B. Tuthill. These officers and Mrs. Harriet M. Converse, Mrs. Anna P. Draper, and Mrs. Mary J. Field, constitute the Executive Committee. Papers were read at the meeting by Prof. Bolton on Divination by the Mirror as practiced in New York Today, and by George Bird Grinnell on How the Pawnees stole the Corn. Mr. G. F. Kunz exhibited a human tooth inlaid with jadeite. Mr. Newell, founder and secretary of the National Society, was present and made some remarks.

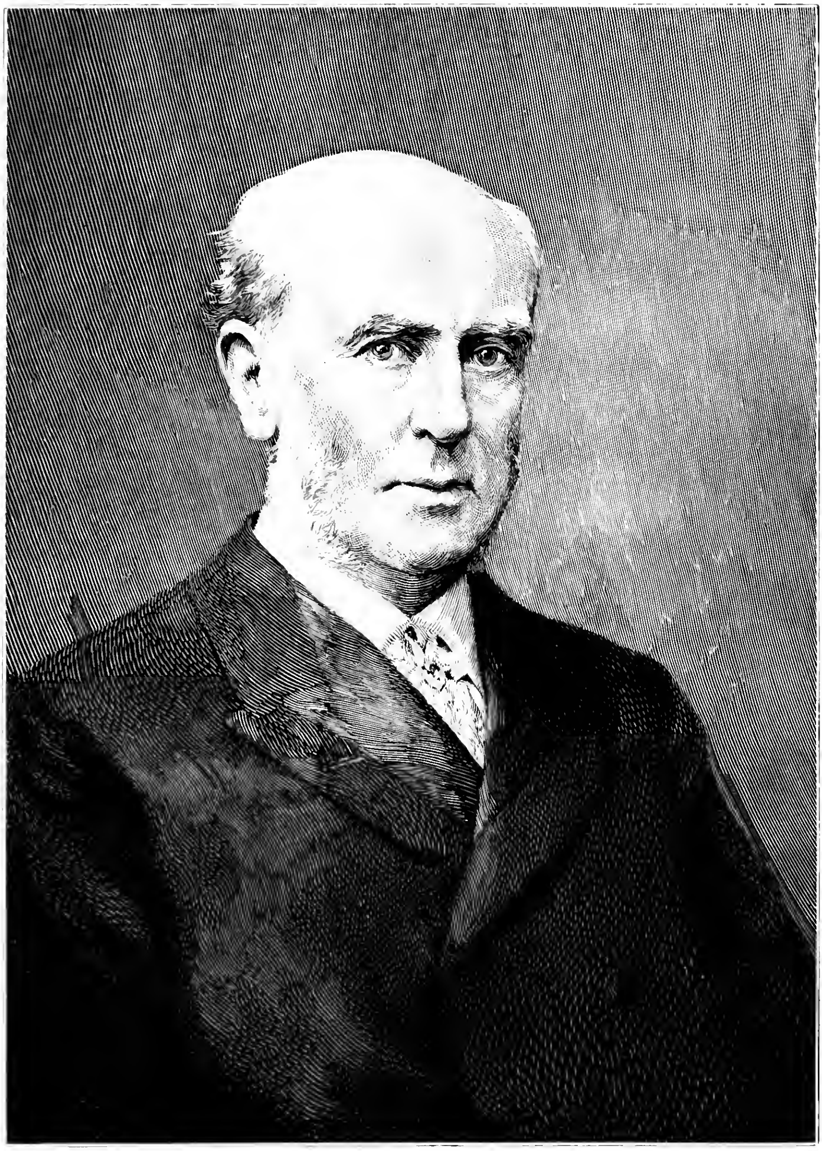
## OBITUARY NOTES.

The death was announced about the beginning of the year of General Axel Wilhelmovitch Gadolin, of the Russian army, an eminent mineralogist and physicist, and a member of the Russian Academy of Sciences. He engaged, when not active in military duties, in research into the molecular forces that act in the formation of crystals. His chief work, which is also known to the world through a German translation, was his Deduction of all the Systems of Crystals and their Derivates from a Unique Principle. A paper on the resistance of the walls of a gun to the pressure of gunpowder gases is also noticeable for having given a new formula of minimal resistance.

Nikolai Ivanovitch Koksharoff, who died in St. Petersburg January 2d, was an eminent mineralogist and author of a work in eleven large quarto volumes, to which a twelfth is to be added, of contributions to the mineralogy of Russia.

M. François van Rysselberghe, Professor of Electrotechnics in the University of Ghent, and a famous inventor, died suddenly at Antwerp, Belgium, February 3d, in the forty-seventh year of his age. Among his inventions were a universal meteorograph, exhibited at Paris in 1881, which registered periodically on a strip of paper the pressure, temperature, humidity, depth of rainfall, and direction and force of the wind; and a system of simultaneous telegraphic and telephonic transmission which has come into general use on urban and suburban lines. He was counsel in electrical matters for the Belgian administration of railroads, posts, and telegraphs.

Mr. Henry F. Blackford, a distinguished geologist and meteorologist of India, died in January. Originally attached to the Geological Survey of India, in connection with which he wrote several memoirs of much value, he afterward became Superintendent of the Meteorological Department of Bengal, and ultimately of the whole of India; and in connection with this position also he published useful books and papers.



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# IRRIGATION IN THE ARID STATES.

By CHARLES HOWARD SHINN.

A MOST vital change is going on in the region west of central Kansas—a change which will in the near future profoundly affect many if not all classes of agriculturists in other American States, and incidentally in Europe also. I refer to the change that has been brought about by the success of private irrigation enterprises, by important alterations in the laws respecting irrigation, by district irrigation under such laws, and by the steady growth of a public sentiment favorable to the irrigator, even when his necessities override ancient precedent.

It is my purpose in this article to give, as far as may be, a faithful and conservative account of the present condition of arid-land irrigation enterprises. My account will be statistical as far as acreage, flow of water, cost of construction, and similar items; it will be descriptive, and largely from personal knowledge, as regards practical methods and their results. The entire subject, it seems to me, possesses an immeasurable interest for farmers elsewhere, and for all who are in any way dependent upon the farming class. Successful irrigation upon a large scale introduces, it is true, a new kind of competition, but it also urges intelligent farmers to adopt improved methods of farming in their own defense, and often leads them to apply the water of neglected streams upon their lands. Even the general reader is often interested in discussions upon farm mortgages, farm rents, wages of laborers, taxes on crops, cost of fertilizers, and similar agricultural problems of the present time, because he has learned that they affect his own welfare. Much broader is the application of arid-land irrigation to every occupation and industry. America

Fig. 1.—Aqueduct at Mission San Juan.

has many and greater valleys of the Nile waiting to pour forth enormous harvests whenever the legislative and executive work of the irrigator has been accomplished.

If I were writing a history of irrigation in America—and a wonderful story it is—I should have to devote a chapter to the Spanish influence in all the lands from Texas to southern California, where men, whose mountaineer ancestors had learned the value of water in arid districts from the builders of the Alhambra, made reservoirs and led many a fertilizing stream to acres of vines and oranges on the high plains about old missions, or in the adobe-walled gardens of newly founded towns, such as San Antonio, Santa Fé, and Los Angeles. I should have to tell about the ruined irrigation canals of forgotten tribes in Arizona, southern Utah, and other regions of the Southwest where hundreds of square miles were covered with a network of water ditches, small and great. The modern irrigator often adopts the grades of these prehistoric channels for his enterprises, finding that no engineer can improve upon them. I should have to describe the fields under the red and yellow heights of Zuñi or Acoma, where the Pueblo Indians still raise their spotted corn by irrigation, as their ancestors did centuries ago, in the bottoms of narrow cañons where the ruins of their fortressed cliff-dwellings still remain. But these things, except perhaps for a passing allusion, are foreign to the purpose of this investigation.

The arid States and Territories are beginning to organize as a group of communities that have common interests and a common purpose. Their respective areas and populations are shown in the following table:

| NAME. | Area, square miles. | Population in 1890. |
|---|---|---|
| Texas | 265,780 | 2,235,523 |
| New Mexico | 122,580 | 153,593 |
| Arizona | 113,020 | 59,620 |
| California | 158,360 | 1,208,130 |
| Colorado | 103,925 | 412,198 |
| Utah | 84,970 | 207,905 |
| Nevada | 110,700 | 45,761 |
| Kansas (west of 97°) | 56,000 | 807,000 |
| Nebraska | 76,855 | 1,058,910 |
| Wyoming | 97,890 | 60,705 |
| South Dakota | 149,100 | 328,808 |
| North Dakota | | 182,719 |
| Montana | 146,080 | 132,159 |
| Idaho | 81,800 | 81,385 |
| Oregon (eastern) | 48,000 | 113,767 |
| Washington (eastern) | 35,000 | 149,390 |
| Total | 1,652,060 | 7,480,573 |

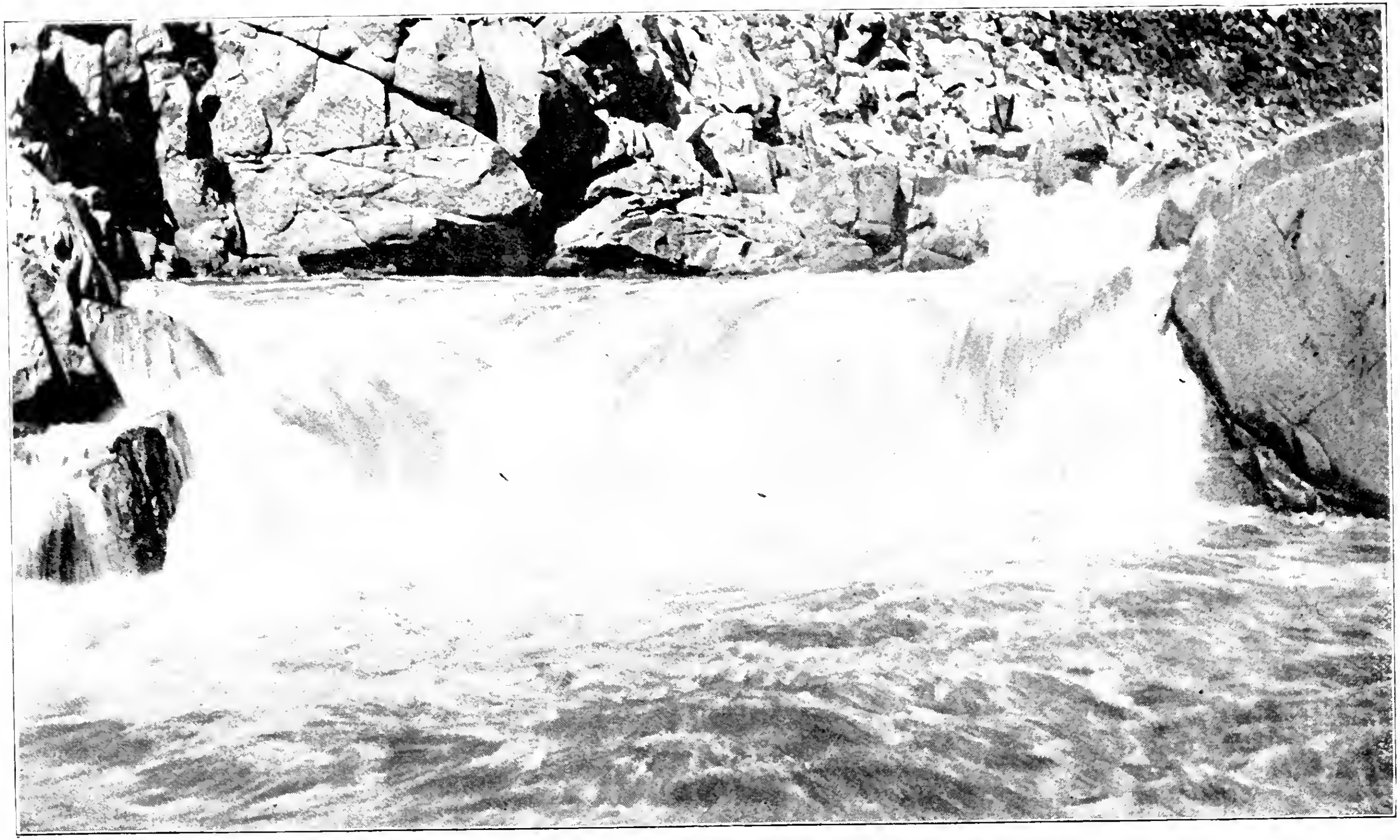

Fig. 2.—In Kern Cañon.

The total area is more than half of the United States (without Alaska), and the total present population is less than one eighth of the population of the United States.

It is difficult, perhaps impracticable, to divide States once created. Although a respectable minority in California and Texas favor division schemes, which would make of the former three States, and of the latter four, the tendencies of the time are against it. But with the Territories it is different; and if admission is long delayed, so that irrigation developments will have enabled the soil to sustain a dense population, such Territories as Arizona, New Mexico, and Utah are very likely to be divided. Eastern Oregon and Washington are separated by diverse interests from the western slopes of those States in somewhat the same way as southern California is separated from the northern counties. If the desire for smaller States should increase in the future, it is not impossible, therefore, that the States and Territories of the arid belt should some time contain twenty-five or thirty political divisions instead of sixteen, as at present. It is perhaps too much to say that the balance of power can ever be transferred from the Mississippi Valley to the ultimate West of the Rockies, the Great Basin, the valley of the Rio Grande, the irrigated leagues of the Nevada and Arizona deserts, the vast valley plains of the Sacramento and San Joaquin, the mountains of Coast Range, Cascade, and Sierra. But if such a change is ever brought about, the irrigator will be the principal cause of the transfer of leadership from the man of the corn lands to the man of the fruit lands.

Twenty years ago no one in America knew how to utilize water on a large scale for irrigation. A few colonies in different parts of the arid zone, a few settlers in isolated valleys, were making experiments. Half a dozen ranchers would come together and plow an open ditch two or three feet wide, to irrigate their crops in years of severe drought. As for the districts where the average annual rainfall was below the required amount, no one tried to live there. But some of the most successful of recent enterprises have been upon lands where there is "no rainfall." Even ten years ago, though the number of colonists had increased, the total area under water ditches in the arid region was hardly more than two million acres. In 1886 it had increased to five and a half million acres, and the following table shows the state of affairs in 1891:

*Irrigated Areas in Arid Region.*

| State or Territory. | Acreage under ditch. | Acreage cultivated by the irrigators. | Artesian wells. |
|---|---|---|---|
| California | 4,500,000 | 3,550,000 | 3,500 |
| Wyoming | 3,031,484 | 185,000 | 6 |
| Colorado | 3,007,050 | 1,800,000 | 4,500 |
| Montana | 1,250,000 | 419,000 | 36 |
| Idaho | 1,200,000 | 330,000 | 12 |
| Kansas (west of 97°) | 990,000 | 120,000 | 50 |
| Utah | 735,000 | 423,000 | 2,524 |
| New Mexico | 700,000 | 405,000 | 10 |
| Arizona | 660,000 | 315,000 | 42 |
| Texas | 350,000 | 160,000 | 1,000 |
| Nebraska | 200,000 | 40,000 | 1,000 |
| Washington | 175,000 | 75,000 | 10 |
| Nevada | 150,900 | 75,000 | 76 |
| Oregon | 125,000 | 45,000 | 6 |
| South Dakota | 100,000 | 54,000 | 960 |
| North Dakota | 2,500 | 2,000 | 670 |
| Total | 17,177,843 | 7,998,000 | 13,492 |

Some of the artesian wells are of enormous size, and yield four and five million gallons of water daily, capable of irrigating a section of land. The greater number are small, however, and probably not capable of irrigating more than five or ten acres. Half a million acres is the utmost limit of the present wells. Some artesian districts contain at least that acreage, so that, if the water supply is sufficient, a vast area will be reclaimed by this method.

In the above table the most noticeable fact is that less than half the area lying beneath the water ditches, and capable of irrigation, is now cultivated. This is because it takes a number of years to settle the country, break up the soil, and bring it into cultivation. In progressive communities the possible acreage keeps ahead of the demand until the water supply or the land supply is exhausted. Judging the future by the past, and taking into consideration many projected ditch lines, there will be from thirty to thirty-five million acres under some irrigation system by the close of the decade, and the actually cultivated area may be close upon twenty million acres.

California has had a longer and more extensive experience with irrigation than any other division of the arid belt, and immense sums have been wasted in litigation and experiment. The systems now in use in different districts illustrate all the details of the business. All the larger problems connected with irrigation, such as seepage, drainage, reservoirs, alkali deposits, economy in distribution, can be studied in the valleys of California. More particularly one sees private ownership and district ownership in operation side by side, often in the same county.

The Wright irrigation act, passed in 1887, gave a great impetus

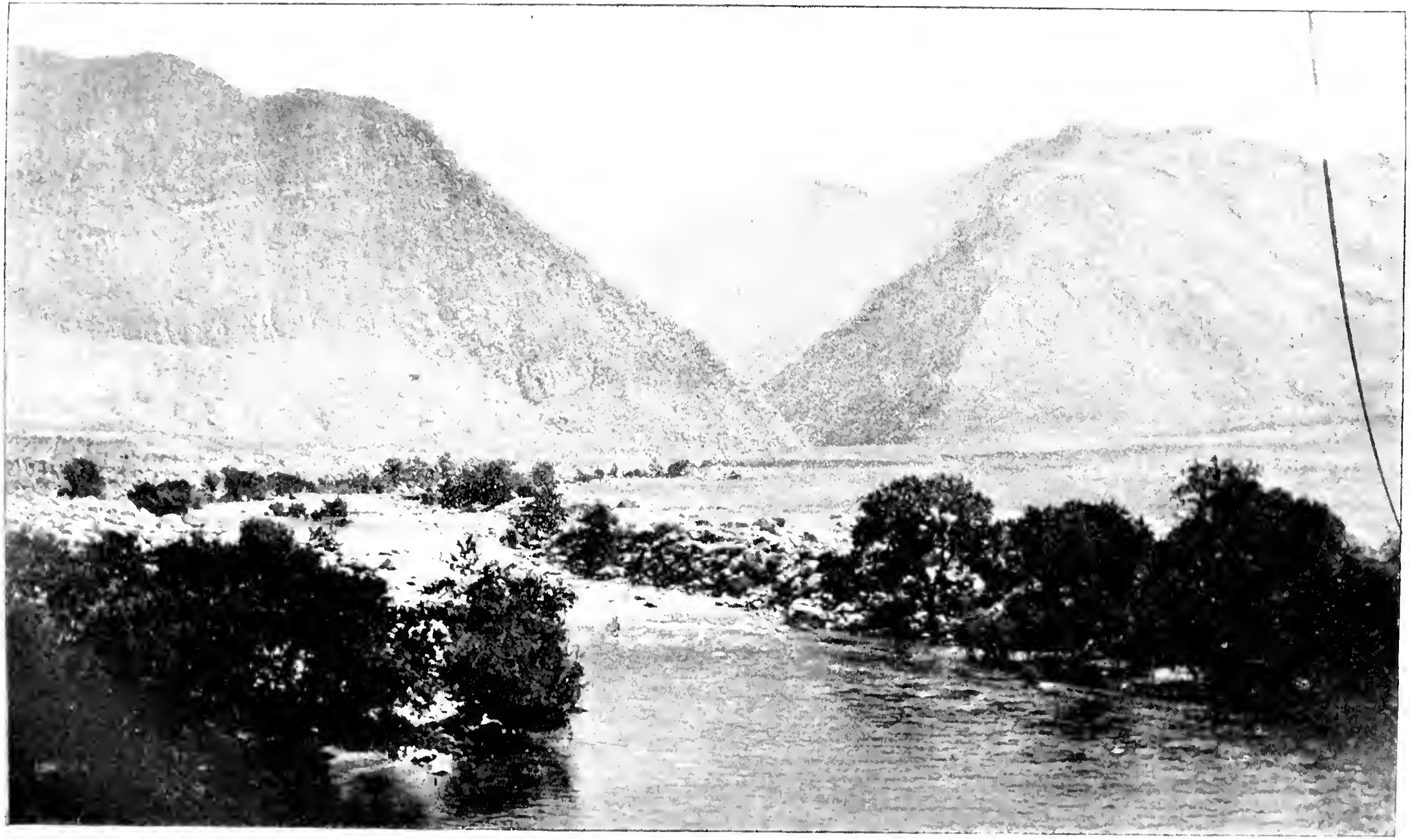

Fig. 3. Coming out on the Desert.

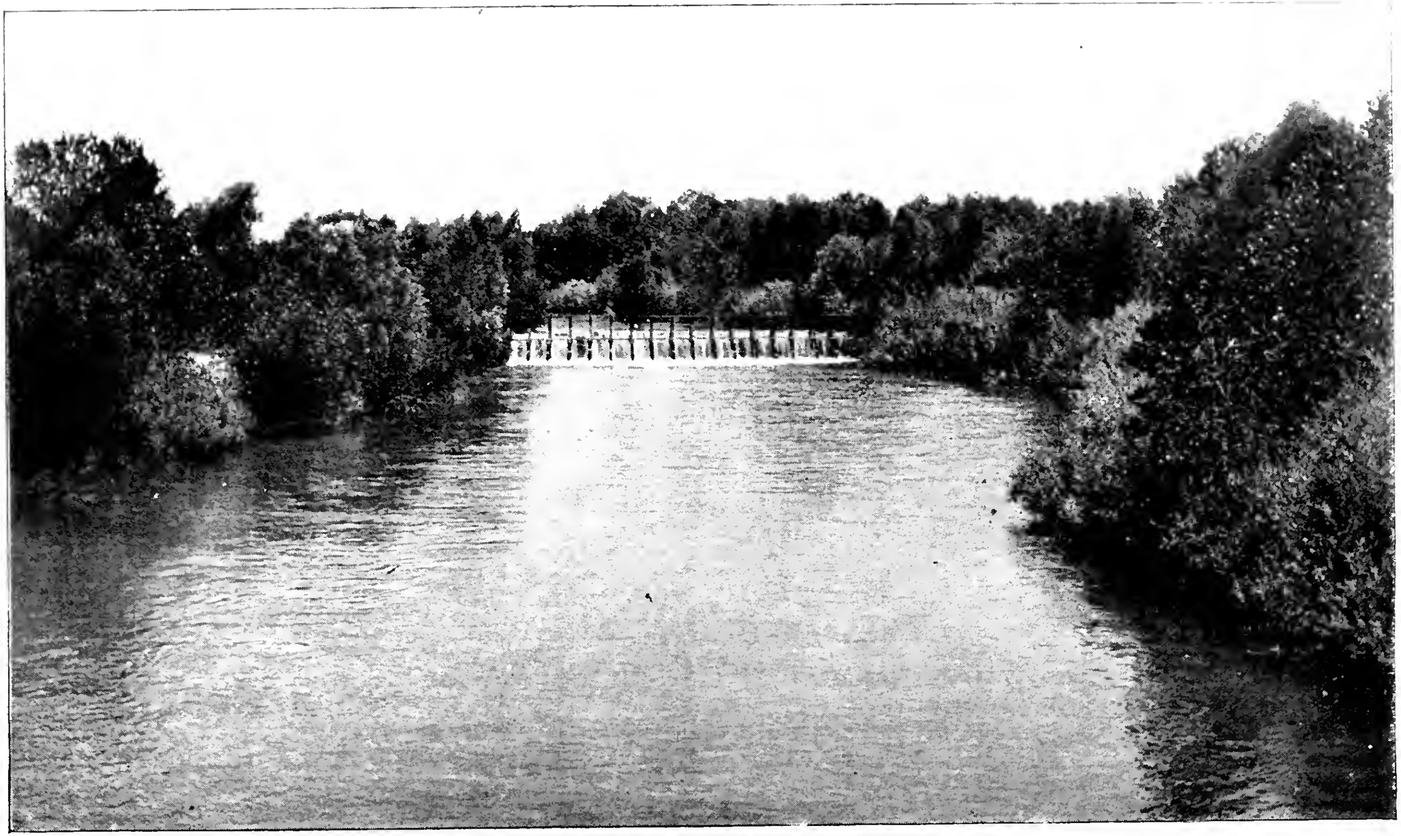

Fig. 4.—The Calloway Canal.

to the process of uniting land and water in a permanent union. No less than thirty-eight districts have been organized already, and they include a total of about two and a half million acres, upon which bonds to the extent of twelve million dollars have been voted. About three million dollars in bonds have been actually issued and sold; seven districts have some of their ditches constructed and full of water; one has completed its entire irrigation system and is in successful operation. It will take a considerable time to obtain the desired capital and complete all the districts organized. Some of them are very large, and will greatly add to the irrigated area. The following table shows the acreage and estimated cost of water supply in the ten largest districts:

*Irrigation Districts.*

| NAME. | Acreage. | Estimated cost. |
|---|---|---|
| Sunset | 363,000 | $2,000,000 |
| Madera | 308,000 | 850,000 |
| Selma | 271,000 | 1,000,000 |
| Turlock | 176,000 | 1,200,000 |
| Central | 156,000 | 750,000 |
| Alta | 129,000 | 675,000 |
| Colusa | 100,000 | 600,000 |
| Kern and Tulare | 84,000 | 700,000 |
| Modesto | 80,000 | 1,400,000 |
| Palmdale | 150,000 | 175,000 |
| Total | 1,717,000 | $9,350,000 |

The bulk of the district acreage is included in these ten districts, nine of which are situated in the San Joaquin and Sacramento Valleys. The lowest estimate of cost in any of the thirty-eight districts is $2.56 per acre, and the highest is $83. The last is in the famous orange colony of Riverside, where the water is piped to the land, and where the science of irrigation is perhaps better understood than in any other colony in America. The average first cost of water per acre is a little over eight dollars. Bonds issued are a lien upon all the real estate within the boundaries of the district, as well as upon the irrigation system itself, and are considered by conservative bankers as excellent security.

Beyond doubt the irrigation district laws of California are full of suggestion for cheap and effective work by the land-owners themselves. They are best adapted to communities that have learned something of the value of irrigation and can work together. There are many places where no irrigation will be done until the Government or some private corporation takes hold with the required skill and capital to secure the water and distribute it to the land; then the scattered settlers will use it, and others will come in and buy the land and water. Some of the irrigation dis-

Fig. 5.—One of the Branch Canals.

Fig. 6. Grapes from the Desert.

tricts already organized are meeting with bitter opposition from large land-owners who do not wish to sell, nor to pay higher taxes upon more valuable because more fruitful land. The average farmer with his hundred or five hundred acres, where crops fail one year in three or two in five, is compelled to have water or become bankrupt. The owner of fifty or a hundred thousand acres pastures cattle there and makes a living that suits him. If the small farmers form an irrigation district, the cattle baron is apt to fight it on general principles, and if they outvote him and include any of his land in the taxable area, he fights them to the end. Several of the most promising district ditches of California are lying unfinished at the present time because of the stubborn opposition of the large land-owners, some of them living in Europe.

Private ownership of irrigation canals exists more or less in every county of California. It is too soon to decide the comparative cost of water under the two systems, but the logic of the situation requires supervision of private enterprises by either the State or the General Government. The danger in many private schemes is the sale of more water than can be supplied in seasons of drought, and the consequent loss of crops planted in the expectation of receiving an abundance. There is a golden mean between this extreme and the other, now less frequent than formerly, of claiming ten times as much water as can be used and allowing it to go to waste. One of the greatest corporate irrigation enterprises in the United States is in Merced County. The late Charles Crocker, of San Francisco, was the leading stockholder. Three and a half million dollars has now been spent upon a fifty-mile canal from the Merced River, with a hundred and fifty miles of lesser ditches; a giant reservoir, Lake Yosemite, covering a square mile thirty feet deep, and the purchase of large tracts of land. The company now has water to irrigate six hundred thousand acres. The carrying capacity of the main canal is not less than four thousand cubic feet per second. Colonies are springing up along the line of the canal, and thousands of acres have been planted to crops that justify irrigation.

A still better illustration of what private enterprise has done in this field is shown in the Kern region. Seven hundred miles of large irrigating ditches have been dug in this imperial county, which contains more than five million acres. The annual rainfall is from three to five inches, so that irrigation is absolutely necessary. Thirty large canals have been taken out of Kern River, which rises in the highest part of the Sierra Nevada Mountains. The most famous of these canals is the Calloway, eighty feet wide on the bottom and one hundred and twenty feet wide at the top, seven feet in depth, and usually full to within a few

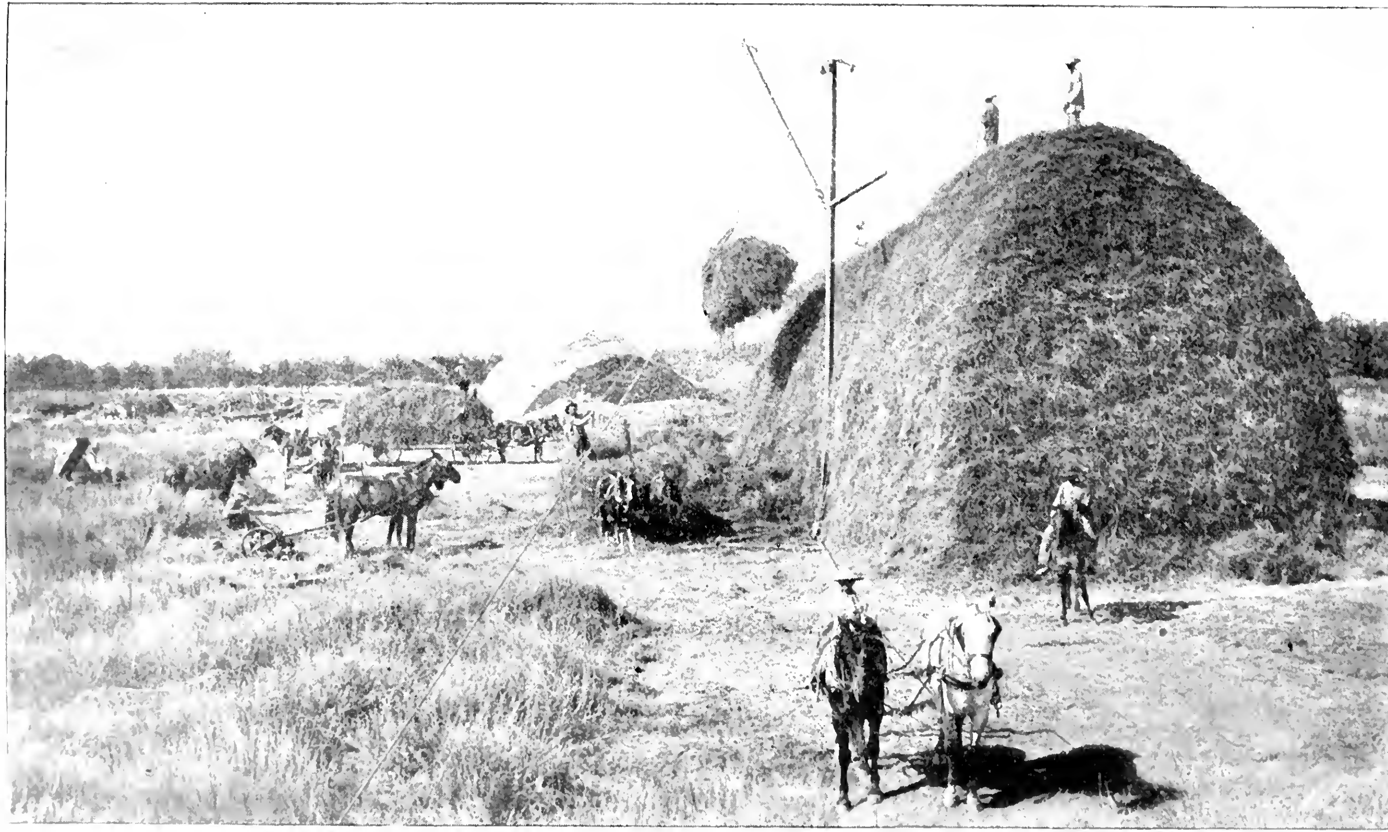

Fig. 7.—Alfalfa Fields in the Desert.

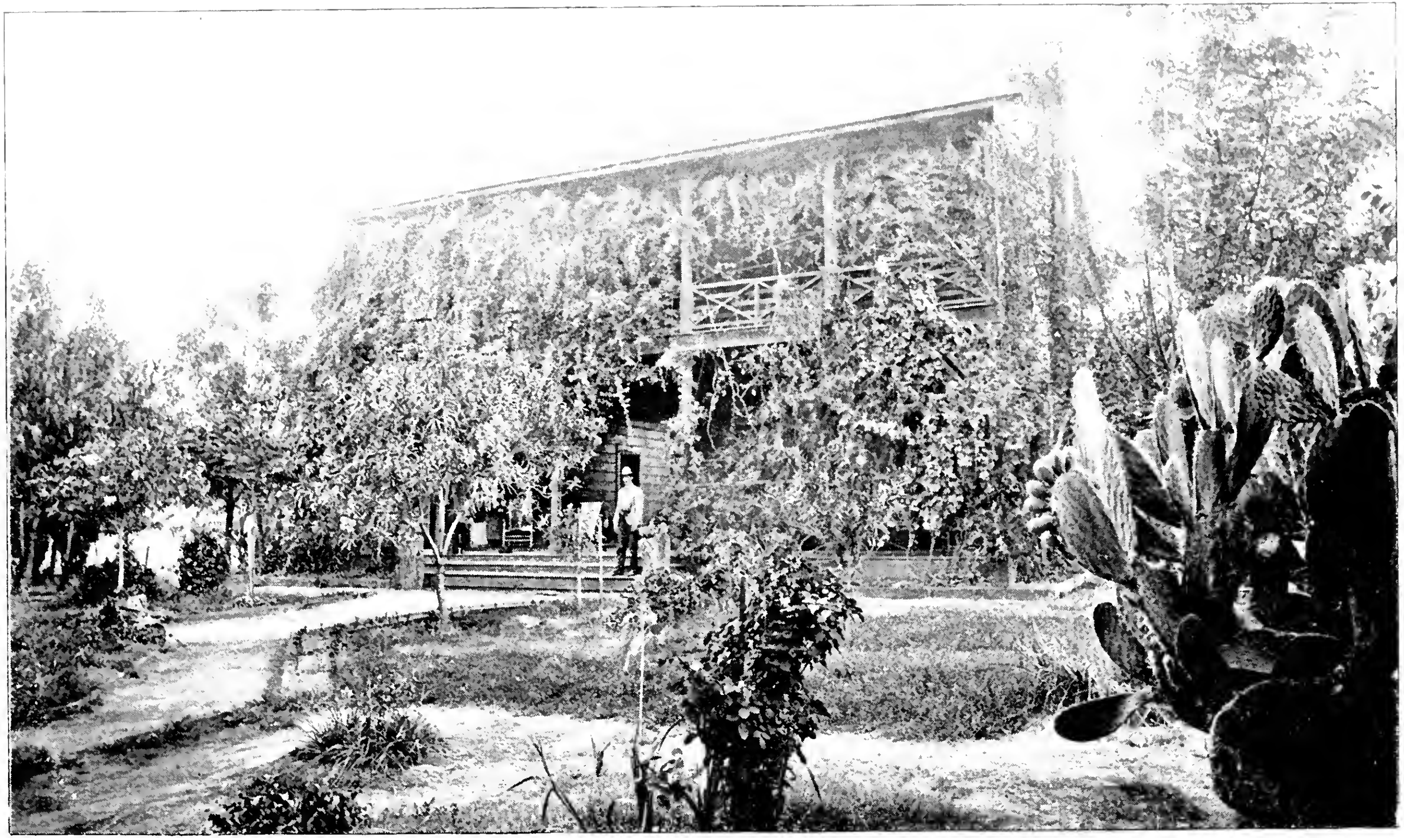

Fig. 8.—After Ten Years' Irrigation on a Barren Sand Plain.

inches of the top of the bank. It irrigates two hundred thousand acres through sixty-five laterals, of an aggregate length of one hundred and fifty miles.

But the glory of Kern is the enormous irrigation system upon the Kern Delta, constructed by two San Francisco capitalists—Lloyd Tevis and J. B. Haggin. All in all, it is the largest enterprise of the kind of which I have any knowledge. The total expenditure has been fully four million dollars. For this the owners have obtained a system of twenty-seven main canals with an aggregate length of three hundred miles, besides about eleven hundred miles of permanent laterals. Six hundred thousand acres can be watered from these artificial rivers. The sandy plain slopes south and west upon a grade of five or six feet to the mile. Very little of the land requires leveling. The great reservoir, a former lake basin, covers twenty-five thousand acres and contains fifty billion gallons of water. The various canals of this company and others take from Kern River alone a total of twelve thousand cubic feet of water per second.

Twenty years ago the value of such land was less than a dollar an acre. No settler could live on a quarter section, and like Fresno, Tulare, and in fact most of the San Joaquin Valley, it was used only for pasturage. To-day there are fields of hundreds of acres of alfalfa, where the best of Jerseys and Holsteins are kept: there are orchards of peaches, apricots, prunes, and almonds—thousands of acres—loaded each year with fruit: cotton, sugar beets, the sugar cane of Louisiana, tobacco, corn, cassava, and a multitude of the products of the temperate and semitropic regions thrive here and can be grown as staple crops.

Irrigation is often supposed to belong only to the arid lands. There, it is true, it produces the most surprising changes and the greatest proportionate increase of values. Water poured upon a rainless desert makes it blossom under the tropic sun as if some magician's wand had been waved over it. Vines, fruits, flowers, green lawns, golden wheat, and silver barley, for miles on miles, all lifted by the sparkling rivers above the fluctuations of the season—such are the changes the irrigator brings to the desert. But thousands of valleys and hillsides in the arid regions have enough rainfall to enable farmers to struggle along, and not enough to make their crops a certainty every year. Here there is an even more immediate need of water to supplement the natural supply. No available statistics can illustrate the extent to which pioneers in the Rockies, Sierras, and Coast Range are developing cheaply and easily a local supply of water for their ranches. The last census, which says there are about thirteen thousand irrigators in California (there are really twice as many), is very incomplete in this direction. Besides the organ-

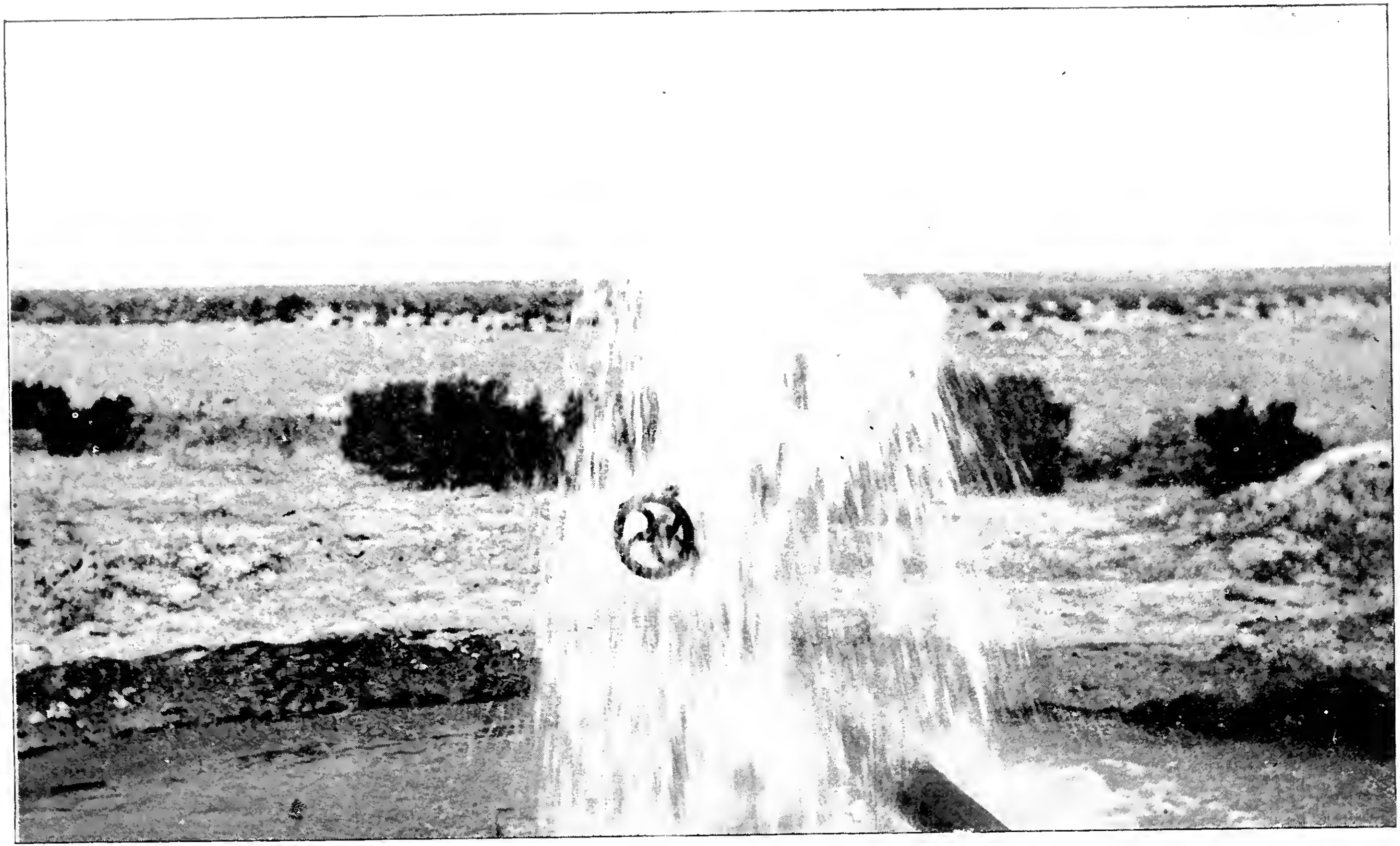

Fig. 9.—An Artesian Well in the Desert.

ized districts and the great irrigation corporations, there are illustrations in thousands of beautiful and fertile valleys, and upon many a sunny hillside, that it pays to irrigate.

In the old placer-mining regions of California one sees much of the local use of water, ranch by ranch, spring by spring, cheaply, easily, and effectually. The miners have long been familiar with the management of water. They built hundreds of miles of hydraulic mining ditches, triumphs of engineering skill, bringing whole rivers from the snow peaks to the beds of gold-bearing gravel below. They siphoned streams over mountains; they belted their flumes in mid-air to perpendicular cliffs of granite a thousand feet from base to crest; they changed little Alpine valleys into mountain lakes. Such men as these find it only child's play to water their hillside gardens, to wall up the "flats" by mountain streams and flood them so that the white clover or alfalfa keeps green there all the year. Thus one finds oases of verdure and fruitfulness about the cottage houses of thousands of mountaineers in Shasta, Trinity, Butte, Lassen, El Dorado, and the whole Sierra range of mining counties south of "Old Tuolumne." Such men as these live in all the mountain ranges of the western half of the continent, and not the least attractive chapter of the story of irrigation is that which tells of their home acres. Even where the annual rainfall is more than sufficient for the ordinary field crops and the deciduous fruits to thrive without irrigation, the dry air and sunlight of the semi-tropic summers often make the application of water desirable for specialized horticulture, or for the greatest obtainable profit from ordinary crops.

Here, then, are the primary schools of the irrigator in the thousands of hidden valleys of Idaho, Dakota, Utah, Colorado, Nevada, and California. Out of them, upon the wide valley plains, upon the vast distances of the high desert mesa lands, the young men of the coming generation of irrigation adepts pass on to greater victories. Artesian fountains spring up along their paths; rivers from regions of mountains, of forests and abundant rainfall, follow in their footsteps; they lead these rivers into the desert and plant gardens there—the grape, the olive, the date palm, the orange, the lemon, the banana, the pomegranate.

The facts and figures which I have used to show the progress of the States and Territories of the arid region are crowded with infinite suggestions and possibilities. Some time, it is not improbable, men may speak of the overflowing granaries, the unparalleled horticultural wealth along the Rio Grande, the Colorado, the Sacramento, the San Joaquin, and other great river plains, as history speaks of Egypt and Assyria in their splendid prime. What are the duties of the American people toward irri-

gation in these all-important years of the beginnings of new commonwealths based upon new industries? Millions of acres of land are forever worthless without water. Who shall own the streams and reservoirs—a few far-sighted men, or the people themselves? Irrigation journals and conventions of irrigators discuss the matter from the standpoint of the present, and endeavor to shape legislation to profitable ends. The slow, dumb masses have not yet recognized the magnitude of the problems involved. An effort is being made to have the United States give all the arid lands to the several States and Territories in which they lie, but the plan is dangerous. Only the Federal Government can protect the sources of water supply; utilize, reservoir, and distribute that supply, and unite water and land in an indissoluble marriage bond.

## THE INADEQUACY OF "NATURAL SELECTION."

By HERBERT SPENCER.

[*Concluded.*]

THIS very pronounced opinion will be met on the part of some by a no less pronounced demurrer, which involves a denial of possibility. It has been of late asserted, and by many believed, that inheritance of acquired characters can not occur. Weismann, they say, has shown that there is early established in the evolution of each organism, such a distinctness between those component units which carry on the individual life and those which are devoted to maintenance of the species, that changes in the one can not affect the other. We will look closely into his doctrine.

Basing his argument on the principle of the physiological division of labor, and assuming that the primary division of labor is that between such part of an organism as carries on individual life and such part as is reserved for the production of other lives, Weismann, starting with "the first multicellular organism," says that—"Hence the single group would come to be divided into two groups of cells, which may be called somatic and reproductive—the cells of the body as opposed to those which are concerned with reproduction" (Essays upon Heredity, p. 27).

Though he admits that this differentiation "was not at first absolute, and indeed is not always so to-day," yet he holds that the differentiation eventually becomes absolute in the sense that the somatic cells, or those which compose the body at large, come to have only a limited power of cell-division, instead of an unlimited power which the reproductive cells have; and also in the

sense that eventually there ceases to be any communication between the two, further than that implied by the supplying of nutriment to the reproductive cells by the somatic cells. The outcome of this argument is that, in the absence of communication, changes induced in the somatic cells, constituting the individual, can not influence the natures of the reproductive cells, and can not therefore be transmitted to posterity. Such is the theory. Now let us look at a few facts—some familiar, some unfamiliar.

His investigations led Pasteur to the positive conclusion that the silkworm diseases are inherited. The transmission from parent to offspring resulted, not through any contamination of the surface of the egg by the body of the parent while being deposited, but resulted from infection of the egg itself—intrusion of the parasitic organism. Generalized observations concerning the disease called *pébrine* enabled him to decide by inspection of the eggs which were infected and which were not: certain modifications of form distinguishing the diseased ones. More than this, the infection was proved by microscopical examination of the contents of the egg; in proof of which he quotes as follows from Dr. Carlo Vittadini:

> "Il résulte de mes recherches sur les graines, à l'époque où commence le développement du germe, que les corpuscles, une fois apparus dans l'œuf, augmentent graduellement en nombre, à mesure que l'embryon se développe; que, dans les derniers jours de l'incubation, l'œuf en est plein, au point de faire croire que la majeure partie des granules du jaune se sont transformés en corpuscules.
>
> "Une autre observation importante est que l'embryon aussi est souillé de corpuscules, et à un degré tel qu'on peut soupçonner que l'infection du jaune tire son origine du germe lui-même; en d'autres termes que le germe est primordialement infecté, et porte en lui-même ces corpuscules tout comme les vers adultes, frappés du même mal." *

Thus, then, the substance of the egg, and even its innermost vital part, is permeable by a parasite sufficiently large to be microscopically visible. It is also of course permeable by the invisible molecules of protein, out of which its living tissues are formed, and by absorption of which they subsequently grow. But, according to Weismann, it is not permeable by those invisible units of protoplasm out of which the vitally active tissues of the parent are constituted: units composed, as we must assume, of variously arranged molecules of protein. So that the big thing may pass, and the little thing may pass, but the intermediate thing may not pass!

A fact of kindred nature, unhappily more familiar, may be next brought in evidence. It concerns the transmission of a disease not unfrequent among those of unregulated lives. The high-

* Les Maladies des Vers à Soie, par L. Pasteur, i, 39.

est authority concerning this disease, in its inherited form, is Mr. Jonathan Hutchinson; and the following are extracts from a letter I have received from him, and which I publish with his assent:

"I do not think that there can be any reasonable doubt that a very large majority of those who suffer from inherited syphilis take the taint from the male parent. . . . It is the rule when a man marries who has no remaining local lesion, but in whom the taint is not eradicated, for his wife to remain apparently well, while her child may suffer. No doubt the child infects its mother's blood, but this does not usually evoke any obvious symptoms of syphilis. . . . I am sure I have seen hundreds of syphilitic infants whose mothers had not, so far as I could ascertain, ever displayed a single symptom."

See, then, to what we are committed if we accept Weismann's hypothesis. We must conclude that, whereas the reproductive cell may be effectually invaded by an abnormal living element in the parental organism, those normal living elements which constitute the vital protoplasm of the parental organism, can not evade it. Or if it be admitted that both intrude, then the implication is that, whereas the abnormal element can so modify the development as to cause changes of structure (as of the teeth), the normal element can cause no changes of structure! *

We pass now to evidence not much known in the world at large, but widely known in the biological world, though known in so incomplete a manner as to be undervalued in it. Indeed, when I name it probably many will vent a mental pooh-pooh. The fact to which I refer is one of which record is preserved in the museum of the College of Surgeons, in the shape of paintings of a foal borne by a mare not quite thoroughbred, to a sire which was thoroughbred—a foal which bears the markings of the quagga. The history of this remarkable foal is given by the Earl of Morton, F. R. S., in a letter to the President of the Royal Society (read November 23, 1820). In it he states that wishing to domes-

* Curiously enough, Weismann refers to, and recognizes, syphilitic infection of the reproductive cells. Dealing with Brown-Séquard's cases of inherited epilepsy (concerning which, let me say, that I do not commit myself to any derived conclusions), he says: "In the case of epilepsy, at any rate, it is easy to imagine [many of Weismann's arguments are based on things 'it is easy to imagine'] that the passage of some specific organism through the reproductive cells may take place, as in the case of syphilis" (p. 82). Here is a sample of his reasoning. It is well known that epilepsy is frequently caused by some peripheral irritation (even by the lodging of a small foreign body under the skin), and that, among peripheral irritations causing it, imperfect healing is one. Yet though, in Brown-Séquard's cases, a peripheral irritation caused in the parent by local injury was the apparent origin, Weismann chooses gratuitously to assume that the progeny were infected by "some specific organism," which produced the epilepsy! And then, though the epileptic virus, like the syphilitic virus, makes itself at home in the egg, the parental protoplasm is not admitted!

ticate the quagga, and having obtained a male, but not a female, he made an experiment.

"I tried to breed from the male quagga and a young chestnut mare of seven-eighths Arabian blood, and which had never been bred from; the result was the production of a female hybrid, now five years old, and bearing, both in her form and in her color, very decided indications of her mixed origin. I subsequently parted with the seven-eighths Arabian mare to Sir Gore Ouseley, who has bred from her by a very fine black Arabian horse. I yesterday morning examined the produce, namely, a two-year-old filly and a year-old colt. They have the character of the Arabian breed as decidedly as can be expected, where fifteen-sixteenths of the blood are Arabian; and they are fine specimens of that breed; but both in their color and in the hair of their manes, they have a striking resemblance to the quagga. Their color is bay, marked more or less like the quagga in a darker tint. Both are distinguished by the dark line along the ridge of the back, the dark stripes across the fore-hand, and the dark bars across the back part of the legs." *

Lord Morton then names sundry further correspondences. Dr. Wollaston, at that time President of the Royal Society, who had seen the animals, testified to the correctness of his description, and, as shown by his remarks, entertained no doubt about the alleged facts. But good reason for doubt may be assigned. There naturally arises the question—How does it happen that parallel results are not observed in other cases? If in any progeny certain traits not belonging to the sire, but belonging to a sire of preceding progeny, are reproduced, how is it that such anomalously-inherited traits are not observed in domestic animals, and indeed in mankind? How is it that the children of a widow by a second husband do not bear traceable resemblances of the first husband? To these questions nothing like satisfactory replies seem forthcoming; and, in the absence of replies, skepticism, if not disbelief, may be held reasonable.

There is an explanation, however. Forty years ago I made acquaintance with a fact which impressed me by its significant implications; and has for this reason, I suppose, remained in my memory. It is set forth in the Journal of the Royal Agricultural Society, vol. xiv (1853), pp. 214 *et seq.*, and concerns certain results of crossing English and French breeds of sheep. The writer of the translated paper, M. Malingié-Nouel, Director of the Agricultural School of La Charmoise, states that when the French breeds of sheep (in which were included "the *mongrel* Merinos") were crossed with an English breed, "the lambs present the following results. Most of them resemble the mother more than the father; some show no trace of the father." Joining the admission respecting the mongrels with the facts subsequently stated, it is tolerably clear that the cases in which the lambs bore no

* Philosophical Transactions of the Royal Society for the Year 1821, Part I, pp. 20–24.

traces of the father were cases in which the mother was of pure breed. Speaking of the results of these crossings in the second generation "having 75 per cent of English blood," M. Nouel says: "The lambs thrive, wear a beautiful appearance, and complete the joy of the breeder. . . . No sooner are the lambs weaned than their strength, their vigor, and their beauty begin to decay. . . . At last the constitution gives way. . . . he remains stunted for life," the constitution being thus proved unstable or unadapted to the requirements. How, then, did M. Nouel succeed in obtaining a desirable combination of a fine English breed with the relatively poor French breeds?

"He took an animal from 'flocks originally sprung from a mixture of the two distinct races that are established in these two provinces [Berry and La Sologne],' and these he 'united with animals of another mixed breed. . . . which blended the Tourangelle and native Merino blood of' La Beauce and Touraine, and obtained a mixture of all four races 'without decided character, without fixity. . . . but possessing the advantage of being used to our climate and management.'

"Putting one of these 'mixed-blood ewes to a pure New-Kent ram. . . . one obtains a lamb containing fifty-hundredths of the purest and most ancient English blood, with twelve and a half hundredths of four different French races, which are individually lost in the preponderance of English blood, and disappear almost entirely, leaving the improving type in the ascendant. . . . All the lambs produced strikingly resembled each other, and even Englishmen took them for animals of their own country.'"

M. Nouel goes on to remark that when this derived breed was bred with itself, the marks of the French breeds were lost. "Some slight traces could be detected by experts, but these soon disappeared."

Thus, we get proof that relatively pure constitutions predominate in progeny over much mixed constitutions. The reason is not difficult to see. Every organism tends to become adapted to its conditions of life; and all the structures of a species, accustomed through multitudinous generations to the climate, food, and various influences of its locality, are molded into harmonious co-operation favorable to life in that locality: the result being that in the development of each young individual, the tendencies conspire to produce the fit organization. It is otherwise when the species is removed to a habitat of different character, or when it is of mixed breed. In the one case its organs, partially out of harmony with the requirements of its new life, become partially out of harmony with one another; since, while one influence, say of climate, is but little changed, another influence, say of food, is much changed; and consequently, the perturbed relations of the organs interfere with their original stable equilibrium. Still more in the other case is there a disturbance of equilibrium. In a mongrel the constitution derived from each

source repeats itself as far as possible. Hence a conflict of tendencies to evolve two structures more or less unlike. The tendencies do not harmoniously conspire; but produce partially incongruous sets of organs. And evidently where the breed is one in which there are united the traits of various lines of ancestry, there results an organization so full of small incongruities of structure and action, that it has a much-diminished power of maintaining its balance; and while it can not withstand so well adverse influences, it can not so well hold its own in the offspring. Concerning parents of pure and mixed breeds respectively, severally tending to reproduce their own structures in progeny, we may, therefore, say figuratively that the house divided against itself can not withstand the house, of which the members are in concord.

Now if this is shown to be the case with breeds the purest of which have been adapted to their habitats and modes of life during some few hundred years only, what shall we say when the question is of a breed which has had a constant mode of life in the same locality for ten thousand years or more, like the quagga? In this the stability of constitution must be such as no domestic animal can approach. Relatively stable as may have been the constitutions of Lord Morton's horses, as compared with the constitutions of ordinary horses, yet, since Arab horses, even in their native country, have probably in the course of successive conquests and migrations of tribes become more or less mixed, and since they have been subject to the conditions of domestic life, differing much from the conditions of their original wild life, and since the English breed has undergone the perturbing effects of change from the climate and food of the East to the climate and food of the West, the organizations of the horse and mare in question could have had nothing like that perfect balance produced in the quagga by a hundred centuries of harmonious co-operation. Hence the result. And hence at the same time the interpretation of the fact that analogous phenomena are not perceived among domestic animals, or among ourselves; since both have relatively mixed, and generally extremely mixed, constitutions, which, as we see in ourselves, have been made generation after generation, not by the formation of a mean between two parents, but by the jumbling of traits of the one with traits of the other, until there exist no such conspiring tendencies among the parts as cause repetition of combined details of structure in posterity.

Expectation that skepticism might be felt respecting this alleged anomaly presented by the quagga-marked foal, had led me to think over the matter; and I had reached this interpretation before sending to the College of Surgeons Museum (being unable to go myself) to obtain the particulars and refer to the records.

When there was brought to me a copy of the account as set forth in the Philosophical Transactions, it was joined with the information that there existed an appended account of pigs, in which a parallel fact had been observed. To my immediate inquiry—"Was the male a wild pig?"—there came the reply: "I did not observe." Of course I forthwith obtained the volume, and there found what I expected. It was contained in a paper communicated by Dr. Wollaston from Daniel Giles, Esq., concerning his "sow and her produce," which said that

"she was one of a well-known black and white breed of Mr. Western, the Member for Essex. About ten years since I put her to a boar of the wild breed, and of a deep chestnut color, which I had just received from Hatfield House, and which was soon afterward drowned by accident. The pigs produced (which were her first litter) partook in appearance of both boar and sow, but in some the chestnut color of the boar strongly prevailed.

"The sow was afterward put to a boar of Mr. Western's breed (the wild boar having been long dead). The produce was a litter of pigs, some of which, we observed with much surprise, to be stained and clearly marked with the chestnut color which had prevailed in the former litter."

Mr. Giles adds that in a second litter of pigs, the father of which was of Mr. Western's breed, he and his bailiff believe there was a recurrence, in some, of the chestnut color, but admits that their "recollection is much less perfect than I wish it to be." He also adds that, in the course of many years' experience, he had never known the least appearance of the chestnut color in Mr. Western's breed.

What are the probabilities that these two anomalous results should have arisen, under these exceptional conditions, as a matter of chance? Evidently the probabilities against such a coincidence are enormous. The testimony is in both cases so good that, even apart from the coincidence, it would be unreasonable to reject it; but the coincidence makes acceptance of it imperative. There is mutual verification, at the same time that there is a joint interpretation yielded of the strange phenomenon, and of its nonoccurrence under ordinary circumstances.

And now, in the presence of these facts, what are we to say? Simply that they are fatal to Weismann's hypothesis. They show that there is none of the alleged independence of the reproductive cells; but that the two sets of cells are in close communion. They prove that while the reproductive cells multiply and arrange themselves during the evolution of the embryo, some of their germplasm passes into the mass of somatic cells constituting the parental body, and becomes a permanent component of it. Further, they necessitate the inference that this introduced germplasm, everywhere diffused, is some of it included in the reproductive cells subsequently formed. And if we thus get a demon-

stration that the somewhat different units of a foreign germ-plasm permeating the organism, permeate also the subsequently-formed reproductive cells, and affect the structures of the individuals arising from them, the implication is that the like happens with those native units which have been made somewhat different by modified functions: there must be a tendency to inheritance of acquired characters.

One more step only has to be taken. It remains to ask what is the flaw in the assumption with which Weismann's theory sets out. If, as we see, the conclusions drawn from it do not correspond to the facts, then, either the reasoning is invalid, or the original postulate is untrue. Leaving aside all questions concerning the reasoning, it will suffice here to show the untruth of the postulate. Had his work been written during the early years of the cell-doctrine, the supposition that the multiplying cells of which the Metazoa and the Metaphyta are composed, become completely separate, could not have been met by a reasonable skepticism; but now, not only is skepticism justifiable, but denial is called for. Some dozen years ago it was discovered that in many cases vegetal cells are connected with one another by threads of protoplasm—threads which unite the internal protoplasm of one cell with the internal protoplasms of cells around. It is as though the pseudopodia of imprisoned rhizopods were fused with the pseudopodia of adjacent imprisoned rhizopods. We can not reasonably suppose that the continuous network of protoplasm thus constituted has been produced after the cells have become adult. These protoplasmic connections must have survived the process of fission. The implication is that the cells forming the embryo-plant retained their protoplasmic connections while they multiplied, and that such connections continued throughout all subsequent multiplications—an implication which has, I believe, been established by researches upon germinating palm-seeds. But now we come to a verifying series of facts which the cell-structures of animals in their early stages present. In his Monograph of the Development of Peripatus Capensis, Mr. Adam Sedgwick, F.R.S., Reader in Animal Morphology at Cambridge, writes as follows:—

"All the cells of the ovum, ectodermal as well as endodermal, are connected together by a fine protoplasmic reticulum" (p. 41).

"The continuity of the various cells of the segmenting ovum is primary, and not secondary; i. e., in the cleavage the segments do not completely separate from one another. But are we justified in speaking of cells at all in this case? *The fully segmented ovum is a syncytium, and there are not and have not been at any stage cell limits*" (p. 41).

"It is becoming more and more clear every day that the cells composing the tissues of animals are not isolated units, but that they are connected with one

another. I need only refer to the connection known to exist between connective-tissue cells, cartilage cells, epithelial cells, etc. And not only may the cells of one tissue be continuous with each other, but they may also be continuous with the cells of other tissues" (pp. 47, 48).

"Finally, if the protoplasm of the body is primitively a syncytium, and the ovum until maturity a part of that syncytium, the separation of the generative products does not differ essentially from the internal gemmation of a Protozoon, and the inheritance by the offspring of peculiarities first appearing in the parent, though not explained, is rendered less mysterious; for the protoplasm of the whole body being continuous, change in the molecular constitution of any part of it would naturally be expected to spread, in time, through the whole mass" (p. 49).

Mr. Sedgwick's subsequent investigations confirm these conclusions. In a letter of December 27, 1892, passages, which he allows me to publish, run as follows:

"All the embryological studies that I have made since that to which you refer confirm me more and more in the view that the connections between the cells of adults are not secondary connections, but primary, dating from the time when the embryo was a unicellular structure. . . . My own investigations on this subject have been confined to the Arthropoda, Elasmobranchii, and Aves. I have thoroughly examined the development of at least one kind of each of these groups, and I have never been able to detect a stage in which the cells were not continuous with each other; and I have studied innumerable stages from the beginning of cleavage onward."

So that the alleged independence of the reproductive cells does not exist. The *soma*—to use Weismann's name for the aggregate of cells forming the body—is, in the words of Mr. Sedgwick, "a continuous mass of vacuolated protoplasm"; and the reproductive cells are nothing more than portions of it separated some little time before they are required to perform their functions.

Thus the theory of Weismann is doubly disproved. Inductively we are shown that there *does* take place that communication of characters from the somatic cells to the reproductive cells, which he says can not take place; and deductively we are shown that this communication is a natural sequence of connections between the two which he ignores: his various conclusions are deduced from a postulate which is untrue.

From the title of this essay, and from much of its contents, nine readers out of ten will infer that it is directed against the views of Mr. Darwin. They will be astonished on being told that, contrariwise, it is directed against the views of those who, in a considerable measure, dissent from Mr. Darwin. For the inheritance of acquired characters, which it is now the fashion in the biological world to deny, was, by Mr. Darwin, fully recognized and often insisted on. Such of the foregoing arguments as touch Mr. Darwin's views, simply imply that the cause of evolution which at first he thought unimportant, but the importance of

which he increasingly perceived as he grew older, is more important than he admitted even at the last. The neo-Darwinists, however, do not admit this cause at all.

Let it not be supposed that this explanation implies any disapproval of the dissentients, considered as such. Seeing how little regard for authority I have myself usually shown, it would be absurd in me to reflect in any degree upon those who have rejected certain of Mr. Darwin's teachings, for reasons which they have thought sufficient. But while their independence of thought is to be applauded rather than blamed, it is, I think, to be regretted that they have not guarded themselves against a long-standing bias. It is a common trait of human nature to seek some excuse when found in the wrong. Invaded self-esteem sets up a defense, and anything is made to serve. Thus it happened that when geologists and biologists, previously holding that all kinds of organisms arose by special creations, surrendered to the battery opened upon them by The Origin of Species, they sought to minimize their irrationality by pointing to irrationality on the other side. "Well, at any rate, Lamarck was in the wrong." "It is clear that we were right in rejecting his doctrine." And so, by duly emphasizing the fact that he overlooked "Natural Selection" as the chief cause, and by showing how erroneous were some of his interpretations, they succeeded in mitigating the sense of their own error. It is true their creed was that at successive periods in the Earth's history, old Floras and Faunas had been abolished and others introduced; just as though, to use Prof. Huxley's figure, the table had been now and again kicked over and a new pack of cards brought out. And it is true that Lamarck, while he rejected this absurd creed, assigned for the facts reasons some of which are absurd. But in consequence of the feeling described, his defensible belief was forgotten and only his indefensible ones remembered. This one-sided estimate has become traditional; so that there is now often shown a subdued contempt for those who suppose that there can be any truth in the conclusions of a man whose general conception was partly sense, at a time when the general conceptions of his contemporaries were wholly nonsense. Hence results unfair treatment—hence result the different dealings with the views of Lamarck and of Weismann.

"Where are the facts proving the inheritance of acquired characters"? ask those who deny it. Well, in the first place, there might be asked the counter-question—Where are the facts which disprove it? Surely if not only the general structures of organisms, but also many of the modifications arising in them, are inheritable, the natural implication is that all modifications are inheritable; and if any say that the inheritableness is limited

to those arising in a certain way, the *onus* lies on them of proving that those otherwise arising are not inheritable. Leaving this counter-question aside, however, it will suffice if we ask another counter-question. It is asserted that the dwindling of organs from disuse is due to the successive survivals in posterity of individuals in which the organs had varied in the direction of decrease. Where now are the facts supporting this assertion? Not one has been assigned or can be assigned. Not a single case can be named in which *panmixia* is a proved cause of diminution. Even had the deductive argument for *panmixia* been as valid as we have found it to be invalid, there would still have been required, in pursuance of scientific method, some verifying inductive evidence. Yet though not a shred of such evidence has been given, the doctrine is accepted with acclamation, and adopted as part of current biological theory. Articles are written and letters published in which it is assumed that this mere speculation, justified by not a tittle of proof, displaces large conclusions previously drawn. And then, passing into the outer world, this unsupported belief affects opinion there too; so that we have recently had a Right Honorable lecturer who, taking for granted its truth, represents the inheritance of acquired characters as an exploded hypothesis, and thereupon proceeds to give revised views of human affairs.

Finally, there comes the reply that there *are* facts proving the inheritance of acquired characters. All those assigned by Mr. Darwin, together with others such, remain outstanding when we find that the interpretation by *panmixia* is untenable. Indeed, even had that hypothesis been tenable, it would have been inapplicable to these cases; since in domestic animals, artificially fed and often overfed, the supposed advantage from economy can not be shown to tell; and since, in these cases, individuals are not naturally selected during the struggle for life in which certain traits are advantageous, but are artificially selected by man without regard to such traits. Should it be urged that the assigned facts are not numerous, it may be replied that there are no persons whose occupations and amusements incidentally bring out such facts; and that they are probably as numerous as those which would have been available for Mr. Darwin's hypothesis, had there been no breeders and fanciers and gardeners who, in pursuit of their profits and hobbies, furnished him with evidence. It may be added that the required facts are not likely to be numerous, if biologists refuse to seek for them.

See, then, how the case stands. Natural selection, or survival of the fittest, is almost exclusively operative throughout the vegetal world and throughout the lower animal world, characterized by relative passivity. But with the ascent to higher types of

animals, its effects are in increasing degrees involved with those produced by inheritance of acquired characters; until, in animals of complex structures, inheritance of acquired characters becomes an important, if not the chief, cause of evolution. We have seen that natural selection can not work any changes in organisms save such as conduce in considerable degrees, directly or indirectly, to the multiplication of the stirp; whence failure to account for various changes ascribed to it. And we have seen that it yields no explanation of the co-adaptation of co-operative parts, even when the co-operation is relatively simple, and still less when it is complex. On the other hand, we see that if, along with the transmission of generic and specific structures, there tend to be transmitted modifications arising in a certain way, there is a strong *a priori* probability that there tend to be transmitted modifications arising in all ways. We have a number of facts confirming this inference, and showing that acquired characters *are* inherited—as large a number as can be expected, considering the difficulty of observing them and the absence of search. And then to these facts may be added the facts with which this essay set out, concerning the distribution of tactual discriminativeness. While we saw that these are inexplicable by survival of the fittest, we saw that they are clearly explicable as resulting from the inheritance of acquired characters. And here let it be added that this conclusion is conspicuously warranted by one of the methods of inductive logic, known as the method of concomitant variations. For throughout the whole series of gradations in perceptive power, we saw that the amount of the effect is proportionate to the amount of the alleged cause.—*Contemporary Review.*

## THE CEREMONIAL USE OF TOBACCO.

By JOHN HAWKINS.

COMPARING the stone age of the New World with that of the Old, an important point of difference comes at once into view. The American race is distinguished in culture from all other savages by the possession and use of an implement to which nothing analogous is found among the prehistoric relics of the Eastern hemisphere. That implement is the tobacco pipe.

Among the aborigines of America the use of tobacco was widely prevalent. The practice of cigar-smoking was observed by the companions of Columbus on his first voyage; and in the brilliant series of discoveries which followed the great admiral's achievement, as well as in the slower process of exploration and colonization, the pipe, the cigar, and the snuff mortar revealed

themselves at every step. Even if written records were wanting, the ancient American smoking implements which enrich the museums of this country and Europe would enable us to assert the general use of tobacco throughout the New World. Combining the written and unwritten records, our information on this point is complete. On the southern continent, although pre-Columbian pipes are occasionally found, smoking was not so extensively practiced as in the north. Still, several varieties of the tobacco plant occur here, and the natives were doubtless well acquainted with its use. Cabral, in 1515, observed in Brazil the practice of chewing tobacco, and on the western coast the abundance of small mortars, carved like the mound pipes of the Mississippi Valley in the shape of various animals, attest the extensive use of tobacco as snuff. Leaving South America and crossing the tenth degree of north latitude, we approach the native land of the pipe. A province of Yucatan is thought by some to have given a name to the tobacco plant. A tubular pipe occurs in the sculptures of Palenque. In Mexico the common custom of smoking was noted by Cortes in 1519, and the truth of his statement is evinced by the quantities of elaborately decorated clay pipes since unearthed in that country, as well as by some of the pictured figures of the ancient manuscripts. Pipes of clay or stone are found in abundance throughout the United States, those from the mounds, sculptured in the form of various quadrupeds and birds, and occasionally of men, being among the most interesting examples of native art. Still farther north the great narcotic had established its sway, prior to the advent of Europeans, beyond the Great Lakes, in the far Northwest, and in the East, where the French gave to a tribe of inordinate smokers the name of Petuns, from *petune*, a native name of the tobacco plant.

The use of tobacco excited in the first Europeans who witnessed it feelings of astonishment and disgust. If Montesquieu is to be believed, the Spanish casuists of the fifteenth century offered to the public conscience, in extenuation of the enslavement of the Indians, the fact, among others, that they smoked tobacco. There is other evidence to show that the early explorers of the New World regarded the custom of smoking as the extremity of barbarism; nor have advocates of this view been lacking from that day to this. But, in spite of all objections, tobacco has extended its reign over the entire earth; it is an important source of revenue to the most enlightened of modern governments; it numbers among its devotees men of all races and of all ranks; it solaces the dreary life of the Eskimo and of the Central African savage; but a little while ago it furnished inspiration to the genius of one of the world's great poets. Concerning the adoption by civilized people of a barbarous custom like that under discussion

much might be said; but leaving this for the present, I desire to call attention to a phase of the subject which has received but little attention, namely, the ceremonial use of tobacco by the natives of America.

Since the world-wide diffusion of the tobacco habit, its earliest, and perhaps original, use has been in a great measure overlooked. With the aborigines of America, smoking and its kindred practices were not mere sensual gratifications, but tobacco was regarded as an herb of peculiar and mysterious sanctity, and its use was deeply and intimately interwoven with native rites and ceremonies. With reasonable certainty the pipe may be considered as an implement the use of which was originally confined to the priest, medicine-man, or sorcerer, in whose hands it was a means of communication between savage man and the unseen spirits with which his universal doctrine of animism invested every object that came under his observation. Similar to this use of the pipe was its employment in the treatment of disease, which in savage philosophy is always thought to be the work of evil spirits. Tobacco was also regarded as an offering of peculiar acceptability to the unknown powers in whose hands the Indian conceived his fate for good or ill to lie; hence it is observed to figure prominently in ceremonies as incense, and as material for sacrifice. It will be my task to collect here some of the many observations of travelers, and of students of Indian custom and belief, which illustrate these remarks.

Embalmed in poetry and frequently described in prose, perhaps the most familiar example of the ceremonial employment of tobacco is the use of the calumet, or peace pipe. In its pungent fumes agreements were made binding, enmity was disarmed. It was at once the implement of Indian diplomacy, the universally recognized emblem of friendship, the flag of truce used in approaching strange or hostile tribes, the seal of solemn compacts. Upon its use was founded the widely diffused calumet dance, a performance reserved for occasions when it was desired to express special friendship. Like many other usages connected with the pipe, the calumet, with the traditions which surround it, have survived to the present day. In many parts of Canada and the western United States the visitor to the Indian villages is still expected to present pipes and tobacco as evidences of amity and good will.

There were other sacred pipes besides the calumet, and these were called into requisition on every possible occasion—in the election of chiefs, in the ceremony of adoption into the tribe, at the beginning of a hunt, on going to war, at the end of the harvest, and in innumerable other acts of Indian life, both public and private, as well as in many dances and festivals. Tobacco, in short, was intimately connected with the entire social and reli-

gious systems of the Americans. References to these minor usages are so abundant in the writings of those who have described the customs and arts of the aborigines, and so familiar to the general reader, that they may be here omitted.

Of more importance are the accounts of the employment of tobacco as sacrifice and incense. Hariot, the historian of Sir Richard Grenville's expedition to Virginia in 1584, after speaking of the cultivation and use by the natives of tobacco, or *uppowoc*, says: "This uppowoc is of so precious estimation among them that they think their gods are marvellously delighted therewith; whereupon they sometimes make hallowed fires, and cast some of the powder therein for a sacrifice. Being in a storme upon the waters, to pacifie their gods they cast some up into the aire, and into the water; so a weare for fish being newly set up, they cast some therein, and into the aire; also after an escape of danger they cast some into the aire likewise; but all done with such strange gestures, stamping, sometimes dancing, clapping of hands, holding up of hands, and staring up into the heavens, uttering therewithal, and chattering strange words and noises." In the narrative of the voyage of Drake, in 1572, it is noted that the natives brought little rush baskets filled with *tabak*, offering them to the whites, as the narrator says, "upon the persuasion that we were gods." The Jesuit missionary Allouez, in 1671, visited the Foxes, in the neighborhood of Green Bay, and after some trouble succeeded in inducing them to listen to his preaching, which was, as Parkman relates, so successful at length that when he showed them his crucifix they would throw tobacco on it as an offering. An early missionary among the Hurons states that they worshiped an *oki*, or spirit, who dwelt in a certain rock, and who could give success to travelers. Into the clefts of the rock they were accustomed to place offerings of tobacco, praying for protection from their enemies and from shipwreck. Early explorers frequently refer to offerings of tobacco found near prominent hills, rocks, and trees, and in the vicinity of dangerous rapids and falls—places, as the poet Moore has it—

> "Where the trembling Indian brings
> Belts of porcelain, pipes, and rings,
> Tributes, to be hung in air,
> To the fiend presiding there."

In the narrative of his captivity among the Indians of Lake Superior John Tanner gives a prayer which he heard recited by the leader of a fleet of canoes upon the lake, asking for a safe voyage. At its conclusion the chief threw tobacco into the water, and the occupants of each canoe followed his example. Coming down to more recent times, the presence of two sacred bowlders

near the famous red pipestone quarry of the Coteau des Prairies is mentioned by Catlin, who says that the Indians never went quite to them, but standing some distance away they would throw plugs of tobacco to them, thus asking permission of the indwelling spirits to dig and remove the precious pipestone.

Still later survivals of the ancient customs connected with the use of tobacco may be noted. According to Colonel Garrick Mallery, an instance of the use of tobacco as incense was furnished by the Iroquois as late as 1882. The following words were addressed to the fire: "Bless thy grandchildren; protect and strengthen them. By this tobacco we give thee a sweet-smelling sacrifice, and ask thy care to keep us from sickness and famine." The Iroquois still make an annual sacrifice of a white dog, on which occasions tobacco is solemnly burned. The idea underlying this employment of tobacco is well shown in the prayer which accompanies the ceremony: "I now cast into the fire the Indian tobacco, that as the scent rises up into the air it may ascend to thy abode of peace and quietness; and thou wilt perceive and know that thy counsels are duly observed by mankind, and wilt recognize and approve the objects for which thy blessing has been asked." Another late custom of the Iroquois is thus related by Mrs. Erminnie A. Smith: "In a dry summer season, the horizon being filled with distant thunderheads, it was customary to burn what the Indians call real tobacco, as an offering to bring rain. . . . Every family was supposed to have a private altar upon which its offerings were secretly made; after which that family must repair, bearing its tithe, to the council house where the gathered tithes of tobacco were burned in the council fire. . . . Burning tobacco is the same as praying. In times of trouble or fear, after a bad dream, or any event which frightens them, they say, 'My mother went out and burned tobacco.'" The Cohuilla Indians of California believe in evil spirits called *sespes*, and when they can not sleep they make offerings to these of tobacco. In making their buffalo medicine the Dakotas were accustomed to burn tobacco to bring the herds. Some American Indians before killing a rattlesnake would make an offering to its spirit by sprinkling a pinch of tobacco on its head. Others would beg pardon of a bear which they had killed, and by placing the peace pipe in its mouth and blowing the smoke down its throat, ask its spirit not to take revenge. The Sioux in Hennepin's time looked toward the sun when they smoked, and when the calumet was lighted they held it aloft, saying, "Smoke, sun." A like custom prevailed among the Creeks. Gordon William Lillie ("Pawnee Bill"), speaking of the pipe dance of the Pawnees, says that "before lighting their pipes they throw a pinch of the tobacco into the air. This, with the first three puffs of smoke, which are

also blown high in the air, goes to the good spirit. The ashes they are very particular to throw to the fire, and this is ill luck to the bad spirit. The pipe (the Indian's idol and shrine) is to the Pawnee what the Bible is to the white man, and goes hand in hand with all the principal dances."

The facts of this paragraph are gleaned from the interesting reports made by Miss Alice C. Fletcher upon her studies of various Indian tribes: At the Uncpapa festival of the white buffalo, a priest must be present to fill the pipe, a ceremony performed with a ritual of words, and it is believed that should the person saying it make a mistake, or omit a word, he would incur death from the sacrilege. Relating the details of this festival for publication, the narrators seated themselves toward the sunrise, lighted the pipe, bowed to the earth, and passed it, uttering a prayer. In the Elk mystery or festival of the Ogallala Sioux the pipe is introduced, together with little bunches of tobacco rolled in cloth. It figures also in the ghost-lodge ceremony of the same Indians. The pipe dance of the Omahas is an elaborate ceremony which can not here be adequately described. It is sometimes exchanged between different gentes of the same tribe, but generally between two tribes. The two "pipes" peculiar to this dance are not pipes at all, but only stems, the pipe-bowls being replaced by the heads of ducks. The stems are hollowed carefully, however, and smoking is sometimes simulated, in which cases the symbolism is as binding as when the fumes are present. The perforation of the stems is made quite large, to prevent clogging, which is regarded as a great calamity. Among the Pawnees, if a stoppage occurs in smoking a peace pipe, the bearer loses his life. Only a man who has proved himself valiant in battle, or wise in council, or who has given away horses, can make one of these pipes. The pipes are wrapped in the skin of a wild cat, and the bearing of this roll is a special office. This ceremony, which is accompanied by an elaborate ritual comprising a number of songs, handed down with their archaic words through many generations, was one of the means in ancient times by which possessions were accumulated and exchanged, and honors counted and received. It seems to symbolize fellowship or kinship. The same dance, with a few minor points of difference, is common to the Omaha, Ponca, Otoe, Pawnee, and Sioux tribes. In their journeys to and fro the dance parties are regarded as peacemakers by all who meet them, because of the presence of the pipes. Should a war party come in sight, the warriors would make a wide detour to avoid the group, even though it belonged to the tribe about to be attacked.

The investigations of the Rev. J. Owen Dorsey among the Omahas also reveal many survivals of ancient ceremonies which illustrate the sacred characteristics pertaining to the pipe. This

tribe possesses but two sacred pipes, which are in the keeping of a certain gens, though seven gentes are said to have once possessed pipes which were reserved for ceremonial usages. The two now in existence are called sacred pipes, or red pipes, and are made of the famous red pipestone. The filling of the pipes is not done by the keepers, but by a man of another gens; and, when this official does not go to the council, the pipes can not be smoked, since no one else can fill them. The ancient ritual for this ceremonial filling of the pipes must not be heard, so he sends all the others out of the lodge. He utters some words when he cleans out the bowl, others when he fills it. The pipes are then lighted by the keeper, and are ready for use. In opening, handling, smoking, and emptying them certain regulations must be carefully observed. Any violation of these laws they believe will be followed by the death of the offender. In smoking they blow the smoke upward, saying, "Here, Wakanda, is the smoke." If the presence of enemies renders necessary the sending out of scouts, the pipes are filled and offered to them, and they are solemnly admonished to report on their return only the exact truth, and to be careful to observe well. When the first thunder is heard in the spring the sacred pipes are filled and held toward the sky, while the thunder-god is admonished to depart and cease from frightening his grandchildren. In the time of a fog the men of the Turtle subgens draw on the ground the figure of a turtle with its face toward the south. On the head, tail, middle of the back, and on each leg are placed small pieces of breechcloth with some tobacco. This is to make the fog disappear. Should an enemy appear in the lodge and put the pipe in his mouth, he can not be injured by any member of the tribe, as he is bound for the time by the laws of hospitality, and must be protected and sent to his home in safety. These Indians use the pipe when declaring war and when making peace. Among the Poncas at the election of chiefs, the chiefs-elect must put the sacred pipes to their mouths and inhale the smoke. If they should refuse to inhale it they would die, it is thought, before the end of the year. The election of Omaha chiefs is similar.

Major J. W. Powell states that when the Wyandot tribal council meets, the chief of a certain gens fills and lights a pipe, sending one puff of smoke to the heavens and another to the earth. The pipe is then handed to the sachem, who fills his mouth with smoke, and, turning from left to right with the sun, slowly puffs it out over the heads of the councilors who are sitting in a circle. He then hands the pipe to the man on his left, and it is smoked in turn by each person until it has passed around the circle, after which the sachem explains the object for which the council was called.

A possible evidence of the religious veneration with which the

pipe was regarded in America is furnished by the mound pipes, upon which the native sculptors expended a much greater amount of patient and careful labor than they devoted to any other implement. So skillfully executed are they that Dr. Rau does not hesitate to affirm that modern artists would find no small difficulty in reproducing them, even with the great advantage of metallic tools. These facts seem to have impressed themselves strongly upon the mind of the late Sir Daniel Wilson, who many years ago investigated thoroughly the narcotic arts and superstitions of the Americans, and to whom the writer is indebted for the main idea of the present paper. The mound pipes are, indeed, a suggestive theme, though the conclusions which archæologists have drawn from them are by no means unanimous. A remarkable depository of carved pipes was unearthed by Squier and Davis in one of the mounds of the group known as Mound City, in Ohio. From a single hearth they took nearly two hundred finely sculptured pipes, many of them, however, being broken and injured by the action of fire. Recalling the sacred associations connected in the mind of the Indian with the tobacco plant and the instrument of its use, theorists have found in this mound a possible altar devoted exclusively to nicotian rites. Without discussing the motives which may have led the builders of the mounds to deposit so many of these pipes in one place, we may assume with some confidence that the carved pipes were most probably totems. "Their sacred nature," remarks Henshaw, "would enable us to understand how naturally pipes would be selected as the medium for totemic representations."

Leaving for a time the regions where the pipe occupies so prominent a place in religious rites, we find, on approaching the Rio Grande, that the use of tobacco becomes of far less frequent occurrence. In the pueblos of the Southwest very few pipes have been found. The Indians of this region have, however, a sacred cigarette, the antiquity of which is indicated by repeated allusions to it in the pueblo folk lore. The Navajos share with the Moquis the smoke-prayer, in which the sacred smoke of the cigarette is blown east, north, west, and south, to propitiate the good spirits and drive away the evil ones. Cushing observed that the older men of Zuñi, in smoking cigarettes, would blow the smoke in different directions, closing their eyes, and muttering a few words which he regarded as invocations. In Mexico and Central America the pipe reappears, though here it is evidently of much less importance than in the North. One prominent example of its application to religious uses is furnished by Diego de Landa. In his Relación de Cosas de Yucatan, describing the curious native ceremony of baptism he says: "Tras esto (the priest) ivan los demas ayudantes del sacerdote con un manojo de flores y un

humaço que los indios usan chupar; y amagavan con cada uno dellos nueve vezes a cado mochacho, y despues davanle a oler las flores y a chupar el humaço." That this is not an isolated instance of the use of tobacco in religious practices in these regions is shown by the pipes and cigars pictured in some of the ancient manuscripts. Bancroft states that after some of the hideous human sacrifices made by the people of Central America, great fires were built, into which the men threw pipes, among other offerings. Among the remarkable sculptures of the "Palace of the Sun," at Palenque, occurs the figure of a priest dressed in a leopard's skin, a complicated head dress, and ruffles around his wrists and ankles. In his mouth, supported by both hands, is a tubular pipe, similar in shape and decoration to many that have been found in California and in other parts of the United States. In this figure the learned Dr. Hamy sees, and doubtless correctly, the performance of an act of worship. He says: "Le pontife souffle en l'honneur du Dieu dont l'image est sculptée au fond de la chapelle une large bouffée de tabac," and proceeds to trace the analogies which exist between this practice of the builders of Palenque and the rites of the mound-builders and California Indians, of whose tubular pipes he says: "Elles servent à souffler une fumée consacrée, dans certaines cérémonies religieuses, et le *medicine-man* sait, suivant les besoins, les transformer soit en tubes à ventouse, soit en porte-moxa."

The treatment of disease by means of tobacco and tobacco pipes, which is here suggested, may now claim attention. The "sucking cure," in which the medicine-man or sorcerer applies to the patient's body a tube of stone or bone and pretends to extract through it some small object, such as a stick or stone, is of world-wide distribution. In America the tube used is frequently the tobacco pipe, sometimes empty, and sometimes filled with burning tobacco. Vanegas, an early historian of California, asserts that stone tubes sometimes filled with lighted tobacco were often applied to the suffering part of the patient's body. Forbes states that in the same region, in 1728, Father Luyanto, of the Loreto Mission, "as a preliminary to baptism insisted on the abjuration of faith in the native jugglers or priests, and demanded the breaking and burning of their smoking tubes and other instruments and tokens of superstition in proof of this." Among the modern Apaches the medicine-man's diagnosis of a case is made by the pretended swallowing of a pipe filled with burning tobacco. It works out of his arm or leg, and if white the patient will recover; if colored, he is likely to die. Tubular pipes occur in many parts of the United States, and in California they are numerous. While they were designed primarily as smoking implements, they were no doubt often used, as here indicated, in the treatment of disease.

From the point of view here taken in regard to tobacco its most interesting use by far is for the purpose of producing a state of ecstasy or delirium in which, according to the barbaric theory of animism, the person under its influence could hold communication in dreams and visions with the spirits who brought disease and death, and also with those to whom the savage felt himself indebted for life and all its blessings. The importance attached to dreams by savages is well known. Schoolcraft, in 1823, noted the besotted and spellbound condition of the Indians of the Great Lake regions, due to their implicit belief in the prophetic nature of dreams. "Their whole lives," he remarks, "are rendered a perfect scene of doubts and fears and terrors by them. Their jugglers are both dreamers and dream interpreters." In ancient Mexico the will of the gods was made known to the four chief medicine-men in dreams, and Bandelier recalls the familiar story that Montezuma, previous to the coming of the Spaniards, being alarmed by mysterious prognostics, called upon the old men and women, and upon the medicine-men, to report what they might dream or had dreamed within a certain lapse of time. In the same country certain men were particularly expert in dream interpretation, so much so that they were generally applied to for that purpose.

It should be remembered that the capacity of the Indian to withstand the effect of narcotics is much less than that of the European, and that the native practice of inhaling the smoke secured a far deeper and more lasting effect than the modern method. Oviedo is authority for the statement that tobacco was greatly valued by the Caribbees, "who call it *kohiba*, and imagined when they were drunk with the fumes of it that they were in some sort inspired." The Carib sorcerer, in evoking a demon or spirit from his patient, would puff tobacco smoke into the air as an agreeable perfume to attract the spirit from the afflicted body. With the aid of tobacco smoke and darkness he could also hold communion with his own familiar demon or guardian spirit. "In La Española and the other islands," says Benzoni, "when their doctors wanted to cure a sick man, they went to the place where they were to administer the smoke, and when he was thoroughly intoxicated by it the cure was mostly effected. On returning to his senses he told a thousand stories of his having been at the councils of the gods, and other high visions." The Indians of California sometimes stupefied children with narcotic drink, in order to gain from the ensuing vision information about their enemies. Dr. E. B. Tylor notes similar practices in Darien, Brazil, and Peru. The Brazilian tribes took tobacco to produce ecstasy, and in this state had supernatural visions. The same custom obtained in North America. A peculiar use of the sweat

lodge (a common institution in America) was observed by Loskiel among the Delaware Indians. After a feast in honor of the fire-god and his twelve attendant manitous, a hut was constructed of skins stretched upon twelve poles tied together at the top. Into this hut twelve men were crowded, twelve red-hot stones were placed among them, and upon these stones an old man threw twelve pipefuls of tobacco. The men had to remain inside as long as they could endure the heat and smoke, and when taken out at last they were almost suffocated, generally falling in a swoon. The precise object of this ceremony is not mentioned, but it is probable that the dominant idea was that of a spiritual intercourse between the swooning men and the deities.

The origin of the custom of smoking tobacco may, with some degree of probability, be traced to the ceremonies here recounted. That stage of primitive culture which is characterized by a strong belief in the reality of dream figures and the prophetic nature of visions tended inevitably to engender a class of professional dreamers and soothsayers. When dreams were in great demand, it was natural that some man in every savage community, on account of a mental peculiarity—a taint of insanity, or some powerful nervous derangement—should become distinguished above his fellows for vivid and frequent visions. As the business of the prophet and seer increased, it became necessary for him to adopt artificial measures for bringing on the condition of stupor which was essential to the exercise of his calling. He therefore resorted to fasting, or, more frequently, to the use of narcotic drugs. Along the Amazon the seeds of *Mimosa acacioides* were thus employed; among the Peruvians and the Darien Indians it was the *Datura sanguinea;* in Brazil, the West Indies, and North America the great narcotic was tobacco.

In like manner it may be reasonably conjectured that tobacco did not become an article of sacrifice and incense until it had passed out of the hands of the medicine-men, by whom alone it was at first used. In every age men have offered in sacrifice that which they valued most—the best and first fruits, and the most precious of their flocks. Tobacco must have come into general use and become one of the Indian's most prized possessions before it was offered as a gift to his deities. It is not difficult to trace this advance from its restricted use by professional dreamers as just described. When men had learned that the sacred herb could drive away disease, recall the past and reveal the future, they naturally wished to try its effects upon themselves—to walk in person in the hidden land of spirits, instead of sending the medicine-man as a deputy. Thus, in time, every man became his own seer, tobacco rose in the estimation of the Indian above all his other possessions, and smoking became a common practice.

# AN ETHNOLOGIC STUDY OF THE YURUKS.

By ALCIDE T. M. D'ANDRIA.

THE Yuruks are nomadic tribes whose existence is a phenomenon difficult to understand and to explain. Ethnologists consider them as direct descendants of the Turkomans, whose distinctive features they have preserved; while those properly called Turks, though descendants of the Turkomans, have mingled with Aryan and Semitic races, and lost their original characteristics. Mr. Riegler states that the Turks, owing to numerous crossings with various foreign races for several centuries, present nowadays important modifications in their type; while the ungovernable Yuruks are proud of their savage origin, and value themselves as superior to the Turks among whom they live.

The Yuruk has generally a large head, round face, high forehead, projecting chin, and long though not oblique eyes. His skin is brown, his hair dark or auburn; he has a very strong osseous frame, and is of medium height. Such is the physical description of the Yuruks.

As for the etymology of their name, it is entirely Persian, and is derived from the verb *yurumek*, which means *to walk*. In some provinces of Asia Minor they are called *Gueutchebe*. This word has the same meaning as *yurumek*, and is derived from the verb *gueutchmek*, which may be rendered in English by *to change lodging*. The literal meanings of their names show sufficiently the most striking side of their nature—they are nomadic. Their tribes are scattered over the Asiatic peninsula. Some ethnologists place their number at three hundred thousand, and M. Elisée Reclus reckons as many as a hundred different tribes. Each tribe appoints a chief called a *sheik*. His authority is absolute, and he fills the office of a judge to settle their quarrels.

The chief occupation of the Yuruks is the breeding of cattle. In winter they set their tents near their barns; but when spring approaches they fold them and remove to lands more favorable for the welfare of their animals. Through the warm months of the summer they live in the open air. If they happen to be in the vicinity of a forest, they apply themselves to wood-felling, and they dispose of the product of their labor in the neighboring cities or villages.

Their wives and daughters are very skillful in weaving carpets, particularly one kind known as *kilim*. Each tribe manufactures carpets having the same design and size; each family transmits to the children the design it possesses, and the young girls learn easily the art of weaving without the help of a pattern.

It is unnecessary to say that nomadic life is dear to them, as

can be testified by the following quatrain, which is taken from one of their patriotic songs:

> "There is no rest for the sovereign,
> And glory requires many toils and pains.
> For me, I would not exchange my poor attire
> For all the universe!"

The Ottoman Government has often tried to stop their wandering life, and many severe edicts have been issued for this purpose.

FIG. 1.—YURUK WOMEN AT THE SPRING.

The Sultan's idea was to destroy their tents, so as to confine them in one place where they might apply themselves to agriculture. The nomads submitted for a time, but their cattle in many places suffered so much from the sterility of the soil that the authorities were obliged to grant them again a permit for emigration.

The language of the Yuruks resembles much the Turkish. In their dialect, words and even syntactic forms are also found which recall the Persian and Arabic languages.

Their creed is Islamism, although they do not observe all its precepts. Thus, they build no mosques, and do not confine them-

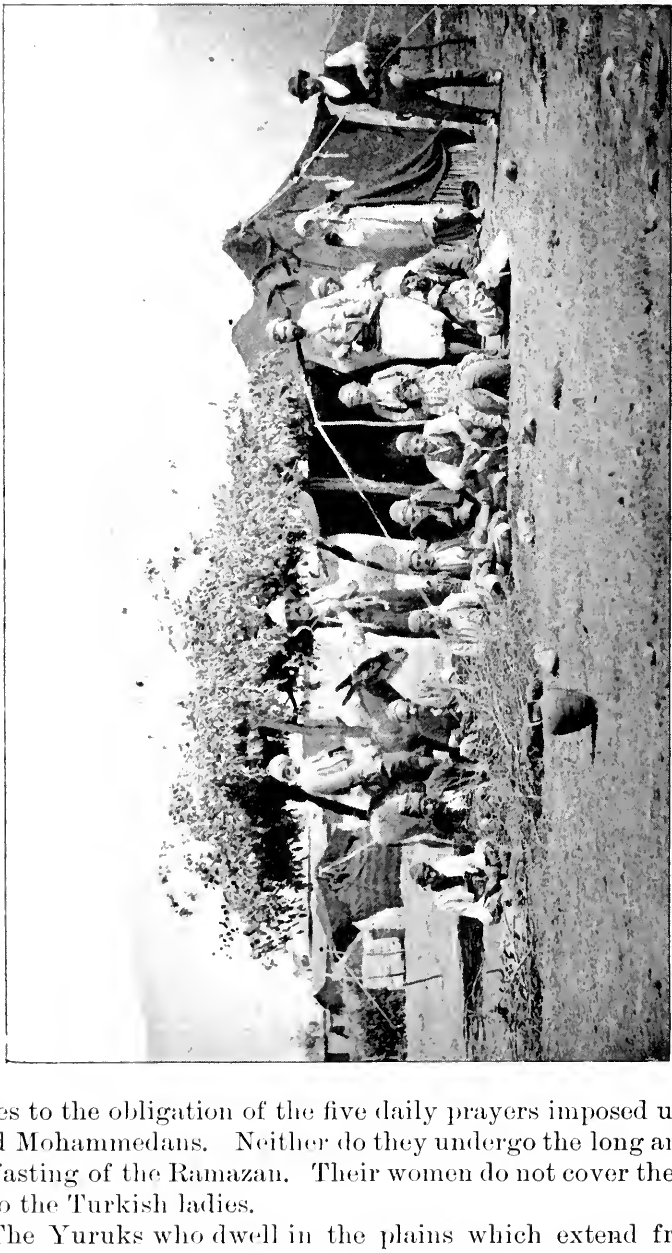

Fig. 2.—Tents of the Yuruks.

selves to the obligation of the five daily prayers imposed upon all good Mohammedans. Neither do they undergo the long and painful fasting of the Ramazan. Their women do not cover their faces as do the Turkish ladies.

The Yuruks who dwell in the plains which extend from the

Sipylus to the Tmolus Mountains are named "Kizil-Bach." Their tribe is the most important and the most numerous; they comprise nearly two thirds of the Yuruk element. In the ethnologic point of view their study presents the most interest.

The Kizil-Bach, as, in fact, all the Yuruks, are the followers of Ali, whom they consider as their prophet. Therefore, Mohammed has no worshipers among them, and this explains why they do not observe the precepts of the Koran.

A curious thing to notice is also a slight mixture of paganism in their creed. For instance, in the spring and fall of every year they set large tents in a remote place, and when night comes men and women gather to celebrate religious banquets and mysterious ceremonies, followed by songs and dances.

Their principal poems express veneration for Ali. They also possess remarkably exalted hymns to chant their adoration to the Supreme Being and their love for their brethren. The dance, performed only by the women, has an original and Asiatic character; its rhythm is grave and slow, the gestures and motions of the dancers show kindness and amiability for their guests. Only those initiated in their mysteries are allowed to attend the above ceremonies, while vigilant and unmerciful guardians, posted in the surroundings, prevent the approach of strangers on pain of immediate death.

Besides these banquets and nocturnal ceremonies, which recall the Saturnalia of the Romans in the time of Tiberius, another fact leads me to believe that the Yuruks have preserved pre-Islamitic doctrines that we can also trace in the darkest paganism. For instance, their belief in metempsychosis. The Yuruks, indeed, assert that human souls return into the bodies of animals, and that the spirits of the latter take also a human form and appear at determined epochs. This is certainly the reason why they are so kind to animals. M. Elisée Reclus says that a Yuruk loves his horse as much as his family. The horses have their place under the tent, and it is not uncommon to see them warmly wrapped in a magnificent robe when the Yuruk and his children are covered with rags. Some other customs attest also a pagan origin; in the Orient everybody knows that the Yuruks worship certain trees and rocks. These facts yield sufficient evidence that monotheism is by no means the essential dogma of their religion.

Among the qualities possessed by the Yuruk, hospitality is, no doubt, prominent. Deprived, by the very influence of his adventurous life, of all the fierce instincts which characterize the Turkomans; restricted, because of his occupations, to the woods, the plains, or the mountains; constantly exposed to the inclemency of the seasons, to dangers and enemies of all kinds, the Yuruk has conceived a generous and noble idea of hospitality, and he prac-

Fig. 3.—Yuruk Encampment.

tices it with disinterestedness and pleasure. His tent, whether in his presence or absence, is always opened to the traveler, and food and drink in abundance are given him The tents of the Yuruks are square, and made of a sort of thick black woolen cloth.

Aside from the information I have given here, nothing precise is known of their private life. For instance, nobody ever knew what became of their dead, as no one has ever seen a cemetery. All I am able to say is that the body of the deceased is placed on a black mule, destined exclusively for that use, and thus carried to a mountain. There, I am not aware whether it is cremated or buried; but, as I was told that they also take a sheaf of firewood, it is safe to believe that cremation takes place.

No traveler has ever seen a Yuruk pray according to any rite. Yet it seems that they are not left without religious instruction, as a venerable old man, his hair dressed as a Persian dervish, comes once a year from Syria and remains awhile among them. The pilgrim becomes the object of their respect and devotion, and they give him the name of father.

Now, who is this man? What affinity between him and these Turkomans? What does he teach them? Why do they call him father? All these questions involve as many mysteries.

Men are often absent in the woods or on the mountains, and their wives remain alone in the tents, but they are secure from all danger, as they have weapons and know how to use them. Among the women they select one in each tribe whose age and personal merits render her deserving of distinction, and they invest her with a superior authority. All the women show her a profound veneration and blindly obey her orders. Even men kiss her hand, and it is customary that every stranger who arrives in the tribe should do the same.

All people agree in acknowledging the good morality of the Yuruk, also his peaceful character, his sober habits and honesty. The very thought of stealing is a crime in his mind, and the weapons he carries he only uses for personal defense.

Here are a few interesting details about the way their marriages are contracted: First of all, I must say that no religious ceremony is performed, as they have neither mosques nor priest, and no person among them is invested with a sacred character. Marriages among young people of different races are strictly prohibited. Therefore, when a young man has remarked among the girls of his tribe the one whom he would like to marry, he delegates a third person, who is usually a friend, to the father of the girl, to announce his intention. If the father sees no objection' the delegate presents him a small sum of money, and that gift in their dialect is called *aghirlik*—that is, *weight*. Afterward the

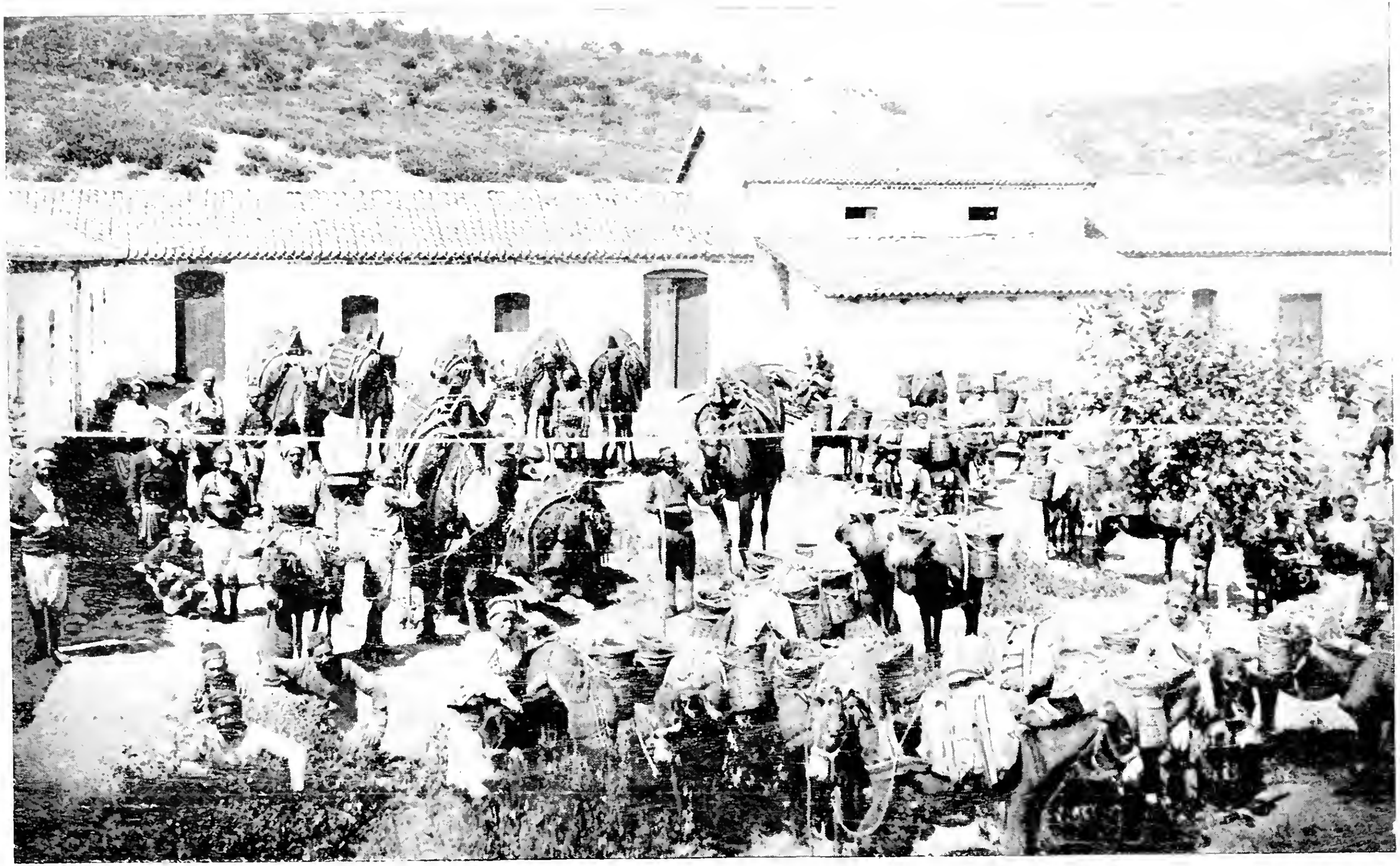

Fig. 4.—Market Day in a Yuruk Village.

parents and friends of the intended go to the tent of the young lady, where, as soon as they arrive, they are offered the sherbet or sorbet, a beverage made with water, lemon, sugar, amber and other spices. The purpose of this visit is to appoint a day for the marriage. When the time comes the young man engages a numerous escort of friends, and they start all together for the tent of the young woman. The bride has also gathered around her a large number of her friends to protect her. When the escort of the groom is near, the bride's protectors utter, at a signal, the wildest cries, run to the aggressors, insult them, and endeavor to defend the access of the tent. Insults and even blows are profusely exchanged between the two camps. This sham fight ends when one of the bravest succeeds in carrying off a goat or a sheep belonging to the father-in-law, and immolates it at once.

The blood shed is considered as a sacred libation, and from that moment the rights of the groom over his wife are recognized. The two families and all their friends are invited to a banquet in which they eat the sheep that was sacrificed.

Before night the bride is escorted to the tent of her husband on horseback. There, before alighting, she must remove the reins from her horse and throw them with force over the tent. If she succeeds in flinging them on the other side, without their touching the tent, they all declare it a happy omen.

At last some women execute dances appropriate to the circumstances, and, as they dance, all armed for the occasion, the effect of their graceful movements, in the magnificence and freshness of the Oriental twilight, is very impressive.

When all these formalities are accomplished, the guests retire, and the husband, accompanied by his most intimate friends, is led to the tent where his young wife awaits him. All the Yuruks espouse one woman at a time; polygamy is prohibited and severely punished.

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Dr. D. G. Brinton and Dr. de la Tourette are agreed that nervous diseases and hysteria are not specially developed by civilization, as is commonly supposed. Dr. Brinton, in Science, quotes travelers for evidence that violent and epidemic nervous seizures are very common in uncultivated nations. Castian describes them among the Sibiric tribes. An unexpected blow on the out-side of a tent will throw its occupants into spasms. The early Jesuit missionaries painted extraordinary pictures of epidemic nervous maladies among the Iroquois and Hurons. Scenes of this kind were witnessed in the middle ages that are impossible to-day. The hypothesis is advanced by Dr. I. C. Rosse, of Georgia Medical College, that a sudden change in the social habit and condition of any race, at any stage of advancement, may result in a prompt development of nervous disease; and that a stable high civilization may excite nervous disorders less than unstable conditions of lower grades of advancement.

# MODERN MIRACLES.

By Prof. E. P. EVANS.

IF, as it has often been stated, the age of miracles in the history of religions is past, it is certain that the age of marvels in the evolution of science is just beginning. The Orient, which from time immemorial has been the chief seat and source of theosophic systems and theurgic traditions, is still peculiarly prolific in all sorts of magical phenomena and other mysterious manifestations.

In illustration of this fact we may refer to the performances of the Arabian fakirs which excited so great astonishment at the Paris Exposition of 1889, and to the more recent but equally wonderful feats of the East Indian, Soliman, in the Panoptikum at Berlin. These fakirs are called *'Aïssavîdya* from the name of the founder of the fraternity, Sid Mohammed Ben 'Aïssa, a saint of royal lineage born at Mekinez, in Morocco, about the end of the fifteenth century. *'Aïssa,* or *'Yissa,* is the Arabic for Jesus: *'Aïssavîdya* is therefore etymologically synonymous with Jesuits, and both orders are really somewhat akin in scope and spirit, although to a superficial observer the Mohammedan society may seem to have little in common with that founded by Ignatius Loyola, except the name and the general principle of absolute obedience, which is thus forcibly inculcated in one of 'Aïssa's statutes: "Thou shalt be in the hands of thy sheik like a corpse in the hands of the embalmer; his commands are the commands of God himself." In this injunction the Jesuitical doctrine of the "sacrifice of the intellect" is pushed to its extreme consequences. It is also a curious coincidence that 'Aïssa should have established in northern Africa a religious order having for its general aim the revival and propagation of Islam, at the same time that Loyola established a religious order in Paris under the same name, having for its object the revival and propagation of Catholicism. Both orders are likewise exceedingly intolerant and fanatical, notwithstanding wide differences in their methods of procedure and the manner in which this zealotry manifests itself.

Besides the common purpose of propagandism as an association, each individual member of the order aspires by means of a severely ascetic life and long-continued physical and spiritual discipline to attain perfection through emancipation from the flesh with all its trammels and torments. In order to arrive at this state, called *Tauhidi,* and corresponding to the *Jîvanmukti* (release from the body before death) of the Hindu *Yogi,* the candidate passes through seven stages of penitential purification, each more rigorous than the preceding one, resulting not only in the com-

plete subjection of the moral and mental faculties of the adept to the will of his superior, but also, as it would seem, in a change of the vital processes and a suspension of the ordinary conditions of bodily existence, which give him immunity from pain and enable him to inflict upon himself wounds that would be fatal to common mortals.

At Paris the performance took place every evening at nine o'clock in the upper story of the Moorish *café*, in the Rue du Caire, of the Oriental quarter. Four 'Aïssavîdya, with their sheik, squatted in Eastern fashion on a carpeted platform, in the center of which stood a brazier of burning coals. The exhibition began with a monotonous sing-song, the burden of which was the invocation of 'Aïssa and Allah, accompanied by a sort of tambourine or tom-tom edged with bells. The music was at first slow and rather low, but soon went faster and grew louder, until it rose to a fearful howl and furious din. At this juncture one of the fakirs sprang up and, throwing off his upper garment, began to dance with his hands on his hips, his head bent forward, and his eyes intently fixed on the sheik. This dance, called *Ishdeb*, became at every moment wilder and the swaying motion of the dancer's body more violent, until he fell down in a fit of exhaustion, foaming at the mouth and his eyes in a "fine frenzy rolling." In this state of ecstasy he is supposed to be possessed by the spirit of 'Aïssa and thereby rendered invulnerable to the sharpest weapons and proof against the deadliest poisons. We may add that Soliman at Berlin prepared himself for the ordeal of fire and sword, not by music and dancing, but by burning a powder and inhaling the smoke, which, however, did not produce any perceptibly stupefying or exhilarating effect upon him. He is a member of the order of Saadi, founded in 1335 by Saadeddin Jebari. Each order seems to have its own method of procedure in this respect, which forms a part of its secret science.

In a short time the fakir had sufficiently recovered from his trance to stand up, and, when the sheik pointed to the brazier, he thrust his hand into it, seized some of the live coals, blew them till they emitted sparks, bit off pieces of them, as one would bite an apple, and eagerly ate them up. He then went to a large prickly cactus, which was standing on the platform, plucked a leaf armed with strong spines, bit off a piece, and swallowed it. With equal avidity he crunched and consumed thin sheets of glass. Fragments of the cactus and the glass were handed to the spectators, who examined them and convinced themselves that they were really the substances they were represented to be. An attendant brought in a shovel, the iron part of which was red-hot, so that a bit of paper thrown upon it flashed at once into flame. The fakir took the wooden handle of the shovel with his right hand, placed

his left hand on the glowing iron plate, which he also licked with apparent relish, and then stood upon it with his bare feet until it became black. This last exploit filled the air with a faint odor of burned horn. A sword, so sharp that it cut a piece of paper in two when drawn across the edge, was handed to the fakir, who thrust it with all his force against his throat, his breast, and his sides. The sword was then held in a horizontal position about three feet from the ground with the edge upward, by the servant who took hold of the point, which was wrapped in several folds of cloth for the protection of his hand, and by another 'Aïssaui, who held it by the hilt. The fakir placed his hands on the shoulders of the two men and, leaping up barefoot on the edge of the sword, stood there for some seconds. He then stripped and, resting his naked abdomen on the edge of the sword, balanced himself in the air without touching the floor with his feet, the sheik meanwhile pressing down upon the fakir's back with the whole weight of his body. The fakir also thrust a dagger from the inside of his mouth through his cheek, so that the point projected more than an inch. Finally, he took a serpent out of a box, and, after irritating it into fierce anger, let it bite various parts of his person; at last he himself bit off the head of the venomous reptile and devoured nearly half of its body.

Having thus gorged his barbarous appetite, he resumed his dance in the same rapid measure, in which he had finished it, but the movement became gradually slower, and in due time, after kissing the yellow turban of the sheik, he sat down again, "clothed and in his right mind."

Another fakir danced himself into a trance and fed upon snakes and scorpions, apparently relishing this limited but piquant bill of fare. In conclusion, the sheik himself performed the most marvelous feat of all: with the point of a dagger he lifted his right eye out of its socket, so that one could see into the cavity, the cornea assuming a dull, glassy appearance so long as the eye rested on the point of the dagger, but no sooner was it replaced and gently rubbed than it became clear again and seemed to be as serviceable as ever. Several medical and scientific men examined the fakir thoroughly after the performance was over, and unanimously declared that none of these feats left the slightest trace of a wound on any part of his body, nor did they draw a single drop of blood. They furthermore affirmed that, so far as they could discover, no jugglery or sleight of hand was practiced.

That these things actually happened is as conclusively established as the occurrence of any event can be by human and even expert testimony. The literature of the subject is quite voluminous and rapidly increasing in extent, corresponding in this respect

with the growth and development of anthropology and ethno-psychology. Missionaries, tourists, government officials, and the most eminent English, French, German, and Italian scientists, who have witnessed these exhibitions in India and other Oriental countries, all agree as to the genuineness of the phenomena, although no one has yet been able to give a satisfactory explanation of them. If we accept the *argumentum ex consensu gentium* as valid, the evidence is overwhelming and the proof complete.

Indeed, one need not go so far away in search of such manifestations. The so-called Choreutæ (dancers) of the fourteenth and fifteenth centuries, the Flagellants of a later period, and similar fanatical sects, are not to be considered in this connection, since their object was to inflict pain upon themselves, the physical suffering being regarded as a sacrament or efficient means of grace. There is, however, quite a remarkable resemblance between the marvelous feats of Arabian and Indian fakirs and those performed by Jansenist convulsionaries in the last century (1730–1762) at the grave of their ascetic saint, Francis of Paris, in the suburban church of St. Medardus, the genuineness of which is not denied by their bitter enemies, the Jesuits, and is even admitted by such scrutinizing skeptics as Hume and Diderot. These religious enthusiasts maltreated their bodies much in the same way as the fakirs and with like impunity, and regarded such actions as contributing to their spiritual growth and perfection. It was a sort of homœopathic treatment, the principle of *similia similibus* applied to the cure of souls, whose infirmities were indicated by bodily symptoms and required vigorous remedies. Thus, an oppression of the chest, which had a pathological significance in relation to the spirit, pointed to the therapeutic necessity of beating it with the greatest violence; if the convulsionary had a sense of burning heat, he exposed himself to the flames; an acute and boring pain in the mouth, neck, eye, or any other organ required a dagger to be thrust into the afflicted part, but, strangely enough, no force could make the sharpest instrument enter the flesh or inflict a wound. If we are to accept autoptic testimony, given by shrewd observers, who would have been glad to expose any imposture, these enthusiasts could eat the most injurious things, swallow poisons, and lie for hours in the fire, like salamanders, without singeing a hair or having any smell of burning on their persons.

Doubtless, as Charcot, Lombroso, Mendel, and other scientists suggest, hypnotism may furnish a partial solution of this physiological and psychological puzzle; but hypnotism, although recognized as a fact, still remains a mystery, and differs from a miracle only in being attributed to natural instead of supernatural causes. It is well known that, in obedience to hypnotic suggestion, persons will eat the most unpalatable and even disgusting substances as

though they were the rarest delicacies; the hypnotic state is also attended by "analgesia" or freedom from pain, and serves as an effective anodyne in dental and surgical operations; but we can recall no well-authenticated case in which it has rendered the human body incombustible. The hypnotizer can prevent the subject of his experiment from feeling the surgeon's knife, or cause him to regard the cutting as an agreeable sensation, but we are not aware that he is able to make the flesh impenetrable to the scalpel, although it is possible for him, as Donato has shown, to thrust sharp instruments into the arm of a hypnotized person without drawing blood or leaving a visible wound. By hypnotic suggestion a man may believe himself to be a dog, a wolf, or any other animal, and act accordingly; and this imaginary metamorphosis may perhaps explain the supposed existence of werewolves. In like manner, pure water may produce an intoxicating effect, while, on the contrary, alcohol ceases to inebriate; and a simple piece of paper placed on the skin may raise a blister, although the strongest irritant fails to do so. Here we have to deal with enigmas of the physical and psychical organization, hitherto unsuspected, the study of which opens up a wide and fruitful field for research.

## THE PHENOMENA OF DEATH IN BATTLE.

By GEORGE L. KILMER.

IN an article printed in the Monthly for June, 1892, I presented some of the phenomena of the soldier's first actions under a death-hurt. A field for investigation lying just beyond that—as I infer from the incomplete records and deductions offered by men of science—is that of the phenomena of death itself. In a casual way I stated in my paper that the symptoms attending death in battle might, in certain cases, be determined by the appearances of the bodies, and cited a remarkable scene at Antietam, where dead Confederates in one place, to the number of several hundred, seemed to have been killed instantly, and to have retained in death something of the last attitudes of their combative life. After my manuscript had been given to the editor, my attention was called to a brief discussion of this question in a sketch by Dr. S. Weir Mitchell, in the Century for February, 1892. The views of Dr. Mitchell are not openly declared in his Century article, but he quotes, on the lips of fictitious characters, the opinions of Generals Grant, Sherman, and Sheridan, and refers to Dr. J. H. Brinton, an army surgeon, who is on record as a very positive witness in this matter. General Sherman, according to Dr. Mitchell, told the story of a soldier killed by a bullet in

the brain while kneeling at a spring to drink, who retained his extraordinary attitude naturally in death. General Grant, when appealed to, said that it could not be true, as he had never seen a single instance where a soldier, shot dead, retained the posture held in life, and his attention had never been called to it in the war. General Sheridan stated that he had often seen it. I wrote what I recalled of the Antietam scene thirty years after, and, never having had a doubt raised but such things could be and were not rare in war, I assumed the phenomenon to be fairly well established, and that citation without proof would not tax the credulity of readers. Yet the denial by General Grant caused me to question my own senses or my memory. As against both Sherman and Sheridan, the one sanguine and imaginative, the other impulsive and good-natured, it would seem that, all things being equal, a question of fact would have the more competent judge in Grant. General Grant went no further in his denial than to say that he had never seen the phenomenon. There are veterans who, having had the best of opportunities for seeing all phases of the battlefield, not only say that they never saw a case of the kind, but, resting upon professional knowledge, assert its impossibility. For my own part, I can report only what I saw in my capacity as a combatant—that is, extraordinary attitudes of dead men on certain fields. Reports of comrades of analogous cases, and the quite prevalent belief that the manifestation was possible, led to the acceptance of it as a natural yet withal a rare occurrence. The fact that military men, and more especially surgeons who have been on the field, are skeptical on the point, that such phenomena are comparatively rare, and that scientific observations have been recorded in but few instances, makes the subject one for extreme caution and conservatism in treatment. In my paper on wounded soldiers I cited the cases of officers killed while leading the charge, who in death held their sword-arms out as when last seen in life. The inference drawn was that death must have been instantaneous. The Antietam scene described was of similar character, yet extraordinary in the number of examples of the same order. I confess that I did not see on any other of the score of fields where I was present a scene at all comparable to that at Antietam, but competent witnesses have reported similar things on other fields, as well as on different parts of that field.

The field of Antietam was peculiarly favorable for the development of the phenomenon, which for brevity, borrowing a term from Surgeon Brinton's record of research, I will call battlefield rigor. It was the hardest fought battle in the East—perhaps in the whole country. The Confederates were at bay, with the Potomac River behind them, and the Union soldiers were exultant over the enemy's dilemma, and the fact that for once battle was

invited on their own soil. Circumstances have relegated it to the background, but at one time it was deemed worthy the best efforts of descriptive writers. Charles Carleton Coffin, the war correspondent and historian, wrote of one of the scenes there in language that will seem to many overcolored. Speaking of an action almost contemporaneous with that at the north cornfield of which I have written, he says: "The Confederates had gone down as grass before the scythe. . . . Resolution and energy still lingered on the pallid cheeks, in the set teeth, in the griping hand. I recall a soldier with the cartridge between his thumb and finger, the end of the cartridge bitten off, and the paper between his teeth, when the bullet pierced his heart and the machinery of life —all the muscles and nerves—came to a standstill. A young lieutenant had fallen in trying to rally his men; his hand was still firmly grasping his sword, and determination was visible in every line of his face."

Curiously enough, Surgeon Brinton's field records, which form the basis of a paper referred to in Dr. Mitchell's remarks on the subject, include three Antietam scenes. The doctor confesses in the opening paragraph of his article (American Journal of the Medical Sciences, vol. xix, p. 87) that this line of investigation was a comparatively new one at the close of the war, 1865. He says: "I have been greatly surprised at the extraordinary attitudes presented by the bodies of those who had fallen with wounds apparently instantaneously fatal—as in the head or heart. In many instances the body was rigid throughout, and the position unquestionably that of the last moment of life. The muscles had, as it were, been surprised by death, and the limbs remained set and fixed in the position held at the moment of the reception of the fatal wound."

In the cornfield, along the sunken road at Antietam (the scene of Mr. Coffin's description), Dr. Brinton saw a Confederate corpse semi-erect, one foot on the ground, one knee against a bank of earth, and one arm stretched forward on a low breastwork. His musket, with rammer in, lay on the ground, and the appearances indicated that he had been killed while rising to load and fire. He was shot through the center of the forehead. In the field adjoining the doctor counted nearly forty dead Confederates, some with their arms rigidly in the air, some with legs drawn and fixed, and many with trunks drawn and fixed. The positions were "not those of the relaxation of death," but were due to "final muscular action at the last moment of life, in the spasm of which the muscles set and remained rigid." The wounds were chiefly in the chest, though some were in the head and abdomen. His observations were made thirty-six hours after death.

Another Antietam case included in Dr. Brinton's list, but re-

ported by Surgeon Thomas B. Read, was the corpse of a Union soldier with his right arm raised above his head and rigidly fixed, his hand still holding the cap with which he had been cheering on his comrades.

Aside from the desperate nature of the fighting at Antietam, the situation was especially favorable to these phenomena, particularly on the Confederate side. They had fought nine battles and engagements within one month, besides marching over two hundred miles. The troops engaged on the portions of the field under consideration had fought at South Mountain two days before—September 14th—had been alert all night on the 14th, 15th, and 16th, marching, countermarching, and skirmishing constantly, and were run down physically from hunger and general exhaustion. They had subsisted for several days upon green corn and apples, and had been one month on half rations of meal and bacon. The day—September 17th—was about like sultry August weather in the North, close and lowery in the morning, followed by a burning sun. The night of the battle was sweltering hot on the field. These circumstances may have played a part in the development of instantaneous rigor.

The first cases that came to the eye of Dr. Brinton were at Belmont, Mo., November 7, 1861. One was a Union soldier kneeling by a tree, in the act of firing, and shot obliquely through the head, front to back. His warm body rested on right knee and leg, left leg bent, with foot on the ground; the left hand firmly clinched the barrel of his musket, which rested with the butt on the ground. The soldier's head drooped to the chest, and rested against the tree. Attitude generally forward, jaw fixed, rigidity perfect. The doctor supposed him to be alive, and could scarcely believe that death rested upon a statue so lifelike. Another Union soldier, shot near the heart, mounted a straying mule and rode beside the doctor some distance. Soon the glazed eyeballs gave unequivocal signs of death, but the body rode on upright. After a time the mule was needed for a live victim, and the body of the other was so firm and rigid that it required force to loosen the knee-grip on the animal's shoulders.

Belmont was fought in autumn, yet the physical activity was such as to generate great bodily heat. It was a running fight for seven hours through wood and marsh. The desperate nature of the struggle is shown by the list of casualties. On the average during the war the proportion of killed and mortally wounded to wounded was one to three. In four of the five regiments engaged at Belmont the proportion was over one to two. The Seventh Iowa lost 188 killed, wounded, and missing. The death-list reached 74, leaving 114 for surviving wounded—over one and a quarter to two.

At Williamsburg, Va., May 5, 1862, Surgeon Read reported a

Zouave with one leg half over a fence, body crawling forward, one hand clinched and raised to level of forehead, with palmar surface outward, as if to ward off evil. Williamsburg was fought during a rain, but the men wore overcoats, the ground was low and heavily wooded, the troops new to war—like those at Belmont—and the mental strain and excitement would be favorable to bodily heat. That field also brought forth a bit of the kind of historical description termed fanciful. It is from the pen of Warren Lee Goss, who has published several narratives of the civil war. He was a soldier in the Union ranks at Williamsburg, and states that after the engagement he visited the scene of a charge in front of the Confederate fort. "Advancing through the tangled mass of logs and stumps, I saw one of our men aiming over the branch of a fallen tree which lay among the tangled abatis. I called to him, but he did not turn nor move. Advancing nearer, I put my hand on his shoulder, looked in his face, and started back. He was dead—shot through the brain—and so suddenly had the end come that his rigid right hand grasped his musket, and he still preserved the attitude of watchfulness, literally occupying his post after death."

A case reported to Dr. Brinton from Goldsboro, N. C., is one of the most striking on record, and it is to be regretted that particulars as to atmospheric and other conditions are wanting. Otherwise the details are most complete. A party of Union cavalry met some dismounted Confederates, and the latter, taking alarm, sprang to their saddles. The Union men fired a volley, and all of the Confederates rode off save one. He was in position preparing to mount, his face turned toward the advancing enemy, who were about to fire again when their leader restrained them, and told them to capture him. Riding up, they found a corpse with one foot in the stirrup, left hand grasping the bridle and mane of the horse, right hand clasping carbine near muzzle, stock resting on ground. Every muscle was rigid in death, and it was difficult to detach the fingers from the carbine, bridle, and mane. The body was laid down, and the same positions and inflexibility were retained by all the members. There were two wounds, one at the right of the spine, emerging near the heart, the other in the right temple.

Another case reported at second hand to Dr. Brinton, but vouched for to him, was that of a cavalryman of the Fourth Wisconsin, who in a skirmish in Louisiana was shot through the heart. His comrades placed him alone in a buggy, which was dragged for an hour by a rope attached to a saddle, the man dying meanwhile, and his body sitting bolt upright and rigid.

The cases examined by Dr. Brinton were sufficient to fully establish all that he claims—namely, the existence of a rigor pecul-

iar to the battlefield which is as instantaneous as the death with which it is synchronous. He states that he frequently passed without examination corpses holding muskets in grasp, pointing forward as if in a charge; bodies prone, face to earth; trunks bent, limbs apparently rigid. From other sources come reports of similar phenomena in more or less details. In a compilation of surgical reports by J. G. Chenu (Rapport au Conseil de Santé des Armées, 1865), Surgeon Perir, from the field of Alma, Boudin from Inkerman, and Armand from Magenta, named many general and special appearances of the phenomena. At Magenta many bodies held to their weapons, even those lying face downward. The conclusion of M. Armand, appended to his report, was that death came so suddenly that the hands had not time to let go. These were head shots. The fighting at Magenta was again terrific, and it was warm June weather. The struggle on the part of the French side was for possession of the town, the key to the position, and it was carried house by house. On the scene of one hand-to-hand combat a corpse was found with the arms raised in front, one bent, one extended, with fists clutched; also a dead hussar on a fallen horse, almost intact in saddle, but leaning on the right side, holding his saber at a thrust. The Magenta cases were seen by the surgeons when forty-eight hours old.

At Inkerman, fought in November, during a dull, foggy rain, M. Boudin saw numberless cases where the bodies rested on the knees, with guns in firm clasp, cartridges in the mouth, and in some instances arms upraised, as though parrying blows. "Long files of the dead seemed to need but the impulse of vital breath to recommence the action of battle." An eye-witness's off-hand description of scenes on that field is found in W. H. Russell's correspondence to the London Times. He said: "The battle of Inkerman admits of no description. It was a series of dreadful deeds of daring, of sanguinary hand-to-hand fights, of despairing rallies, of desperate assaults, in glens and valleys, in brushwood glades and remote dells. . . .

"The British and French, many of whom had been murdered by the Russians as they lay wounded, wore terrible frowns on their faces, with which the agonies of death had clad them. Some in their last throes had torn up the earth in their hands, and held the grass between their fingers up toward heaven."

At Alma, M. Perir saw a great number of cases. One in particular he reported where the body lay upon the side, legs bent, hands lifted at joints, and head thrown back as if in prayer. Alma was fought in September (in the Crimea). Russell termed it one of the most bloody and determined struggles in the annals of war. The allies charged through the waters of the Alma up the steeps to the Russian batteries on the crest.

Instantaneous rigor following violent death has been assumed to be ordinary *rigor mortis*, hastened in development by circumstances, or a rigidity of tetanic character. Dr. Carpenter, the English physician, held to the latter theory, and believed that the rigidity ceased after a few hours, to be succeeded by relaxation and ordinary *rigor mortis* in turn. Dr. Brinton, reviewing all other theories, claimed that the phenomena on the battlefield are unique. "Ordinary *rigor mortis*," he wrote, "is developed after muscular irritability has ceased, but before putrefaction sets in. The appearance of battlefield rigor is probably synchronous with violent death.

"In ordinary *rigor mortis* the march is downward; the parts first affected are the neck and jaw; the lower jaw, if previously relaxed, is drawn up; flexor muscles are supposed to be affected in a greater degree. Battlefield rigor affects probably all regions alike at once.

"Ordinary *rigor mortis* is usually of twenty-four to thirty-six hours' duration; battlefield rigor remains longer than is supposed. . . . The prolonged continuance shows that it is not tetanic nor followed by *rigor mortis* proper." The doctor saw cases of it twenty-four to forty-eight hours and once sixty hours after death. Armand saw it at Magenta twenty-four hours old and Perir at Alma forty-eight hours after death. Dr. Brinton's paper closes with this brief summary of the distinctive features of battlefield rigor:

"The rigor is developed at the instant of death.

"The cadaveric attitudes are those of the last moment of life.

"The death most probably is instantaneous and unaccompanied by convulsions or agony.

"The rigor is probably more lasting than is usually supposed.

"It is extremely doubtful whether this instantaneous rigor of sudden death or rigor of the battlefield is succeeded by flexibility, in its turn to be followed by ordinary *rigor mortis*."

This subject lies, of course, beyond the realm of experiment. If *rigor mortis* is due, as is believed, to solidification of the juices of the muscles by the acid conditions developed therein, marked chemical changes, either rapid or prolonged, follow death under ordinary circumstances. In what degree may the solidification be hastened by extraordinary violence in death? We learn that protoplasm is subject to peculiar changes under peculiar conditions; that it contracts under electric shocks, and that certain forms of it coagulate under temperatures varying from 100° to 122° Fahr., a species of "heat-stiffening" illustrated by the coagulation of the white of an egg. The presence of certain salts will cause muscle juice (myosin) to coagulate at a temperature possible to be attained in the system of a hard-working man on a hot day,

and a slight degree of acidity in the muscle juice lowers the temperature for coagulation; so that hard-worked and heated muscles are, upon chemical grounds, susceptible to the onset of rigor. The most remarkable cases of battlefield rigor seem to develop under extraordinary heat. Given heat and the release of blood pressure, the sudden check of muscular energy consequent upon the wound cuts off from the protoplasm all healthy expenditure of waste, and its action may be brought to a halt so sudden and so effectual as to preclude the slightest change of attitude beyond what may be caused by external forces. Reduced to its plainest terms the idea is as follows: Muscular action and excitement develop heat and chemical action. The myosin, or muscle juice, normally alkaline, is by hard work and excitement rendered acid. Heat and acidity being present in the muscles, tetanic or early *rigor-mortis* contractions might be expected in case of sudden death.

Again, the outstretched hand of the soldier, the grasp of weapons—even the fixing of the eyeballs in angry stare—are acts of the will. If death cuts short the power to will a reaction in the muscles involved by instantly destroying the nerve centers controlling the expanded member, why should the muscles contract any more than they would expand, if death came at the moment of contraction?

The immediate effect of an electric current of lethal energy comes nearest to what must be supposed as the manifestations attending instantaneous death in the heat of individual action. In an electric chair, at the moment of contact with the deadly current, the entire muscular system of the victim is thrown into a state of sudden and severe rigidity, lasting until the electrode is removed. All bodily sensation, motion, and consciousness are suspended at the same time; that is to say, the cessation of consciousness and the physical death—"total paralysis of all the vital organs and the nervous centers by which they are directly or indirectly vitalized, and by which the muscles of the extremities are actuated so that when the current is broken there can be no reflex action of the muscles, such as would indicate the presence of residual life energy or the possibility of resuscitation"—are synchronous. In the case of McElvaine, executed at Sing Sing, February 8, 1892, the reflex action of the voluntary muscles was tested approximately two or three minutes after the breaking of the current, and was found to be "absolutely unresponsive to ordinary mechanical stimuli." Dr. Van Gieson, in his report of the experiment, says: "This tends to show how superlatively complete and far-reaching the effects of the current are in abolishing life, not only in the concrete form, but also in the integral activities of the body, which, in other forms of sudden and vio-

lent death, is liable to persist for a time after life is extinct. From observation at this execution, as well as at the subsequent examination of the body, the current appears at first not only to extinguish life in the ordinary sense of the word, so far as consciousness, feeling, and volition are concerned, with overwhelming suddenness, but reaches beyond this, and destroys the energies of the individual component parts of the body, so that they can not be raised into activity by artificial mechanical stimulation, as is usually the case in sudden violent death."

The same thought has been applied to the phenomena of battlefield rigor. M. Armand wrote of the Magenta cases in 1859, "Death came so sudden that hands holding weapons had not time to let go." Dr. Brinton, in 1865, wrote, "The muscles had, as it were, been surprised by death, and limbs remained set and fixed in the position held at the moment of receiving the fatal wound."

Lightning strokes have produced like phenomena. Men and animals have been found dead in upright postures, a horse even standing on all fours, with his eyes wide open and nostrils dilated by the terror which the storm evoked. If rigidity can be instantaneous in any one case, why not in another where similar causes work upon the same elements?

There is still a link awaiting further physiological research to connect the manifestations attending deaths in battle action with those under the electric current. Huxley asserted that the matter of life depends on carbonic acid, water, and ammonia brought together under certain conditions, and that the withdrawal of any one of them puts an end to vital phenomena; also, that every form of human action is resolvable into muscular contractions, or transitory changes in the relative positions of the parts of a muscle. In 1868 he said: "Perhaps it would not yet be safe to say that all forms of protoplasm are affected by electric shocks; and yet the number of cases in which the contraction of protoplasm is shown to be affected by this agency increases every day."

Therefore the sudden appearance of agents in the nature of electricity and heat may change the combination of acid, water, and ammonia that causes the constant transition of the molecules of a muscle, and when that proportion changes and transition ceases, everything is at a dead stop until other combinations set in motion other changes that give rise to a new order of phenomena. The first stage is vital life, the last putrefaction, and the interim rigidity. The electric current causes unconsciousness and muscular death at one stroke. In battle the wound may produce swift unconsciousness. May it not also let loose a stored supply of heat to augment the already intense heat distributed by the energy of passion and physical action and thus stiffen the

muscle jelly? Or has the capacity for spasmodic reaction been exhausted by the previous overexertion of the soldier—volition being cut short by the wound?

Some men of science not only admit the validity of the evidence offered as to the appearancce of phenomenal rigor under war wounds as well as electric shocks, but assume it as an established physiological fact, without, however, accounting for it. Dr. Mitchell, in his indirect suggestions before mentioned, leaves no reason to doubt that he believes in it. Dr. Brinton and other army surgeons familiar with the phenomenon have speculated as to its causes, and almost all medical men who are not familiar with it in actual experience are curious as to what proof or explanations may be produced.

There is one other form of manifestations of the battlefield almost as unique, though not so startling, as instantaneous rigor, and being more frequently encountered has doubtless impressed itself more widely upon the minds of soldiers and visitants to the field. At first thought it seems but reasonable that the intensity of battle passion and energy should leave its mark upon the forms and features of combatants who die in the midst of the fray. *Per contra*, it seems odd that corpses made so by violence in the midst of violence should sometimes wear on their faces the peaceful look of calmness usually associated with quiet deathbeds. I mentioned in the paper of last year, on wounds, that many of the dead appear to have passed away in a state of mental composure and freedom from pain. Often in contemplating these scenes one is surprised at the contrasts between the happy smile on the dead warrior's face and the blood, the spent missiles, the weapons, and other ghastly symbols of the strife that has passed, lying beside him. Here, again, Nature has wrought a good work. Wrath is soon spent, the inciting din of battle quickly hushed; pain and melancholy thoughts, even surprise that life remains, swiftly loosen the chords that once bound the now suffering man to the warrior's terrible trade. Thought, fanciful it may be but yet enchanting, takes him miles and leagues away, the while his torn body lies not ten feet from the cannon that mangled it, and the smoke of the fatal discharge still hovers about the scene. Again he is only a man. He tries bravely to live, forgetting to hate; makes light of his condition, and may be helps another victim supposed to be worse off than himself. Finally, death steals on while some noble or pleasant thoughts play upon the features. We sometimes found our dead comrades a long distance away from the landmarks on the spots where they fell. This brings up a practical suggestion. Those who fall asleep peacefully die as we would have them if die they must. They usually, however, show unmistakably that they survived their

wound some little time, and the wound often seems trivial to have caused death. Since surgical aid to all is out of the question, why should not every soldier be his own surgeon? Suppose his pack contained a tourniquet, bandages, and lint, to the use of which he has been trained; also, a draught of some strong cordial which might sustain his own life or that of a comrade in extremities, until the relief corps should appear. A simple knowledge of the tourniquet, of bandages, and lint, and readiness to improvise substitutes, have saved countless lives. Lack of knowledge, sometimes, and sometimes an inexcusable lack of materials, have sacrificed thousands. A wounded soldier of our civil war stopped a severe hæmorrhage in the neck by clogging the artery with balls made of sand and blood-clot. He had nothing better at hand.

# THE REVIVAL OF WITCHCRAFT.

By ERNEST HART.

## I.

IN the byways of science, as on the scenes of a theatre and in the pages of fiction, an *alias* is often found to serve a very convenient purpose. But it is always a little disappointing, to those in search of a veritable novelty, to find in place of it only a discredited piece of antiquity, though varnished, polished, and faced with a new color; and it is not inspiriting, even to the *dilettante* of the drama or of fiction, to be put off with old and worn-out characters, masquerading under new names, with fantastic costumes and modern effects, however ingenious and startling.

The modern Athenians, who dignify themselves with the title of psychical researchers, have for some time been inviting us to the investigation of what they have led us to believe were altogether new departures into the domain of mental philosophy. A new horizon was opened out before us; methods of the communication of thought were described which set distance at naught, which dispensed with speech or gesture, touch, sight, or smell. Sensation, we were told, was transmissible without material expression; mental impressions could be conveyed by the unexpressed power of the will, character could be transferred by subtle and invisible channels into those whose morality required strengthening, or whose self-control needed bracing. All this has been indicated with some confidence, and with a careful and measured approximation to methods of rational inquiry, by some English observers whose competence in literature and some departments of physical

research were calculated to invite confidence. But it must be confessed that the results which they had obtained, and the very rudimentary evidence which they had adduced in this country, were far from sufficing to persuade any but a very select band of idealists that there was anything substantial either in their premises or their conclusions. For the last year or two, however, public attention has been invited to a series of phenomena which were seriously alleged to afford positive evidence of the existence of a variety of endowments of the human body, and of marvelous powers of mental action, which realized some of the promised wonders of "the new psychology." France was now, as in the last century, the chosen land of marvel. There appears to be something in the temperament of the Latin race which lends itself easily to neurotic disorder, to hysterical excitement, and to the production of startling displays of mental eccentricity. We have never been celebrated in this country, even in the middle ages, for our demoniacs, our dancing hysterics, or our miraculous cures. We have nothing to rival the ancient histories of St. Medard and Port Royal, or the modern pilgrimages of Lourdes. But if the modern hypnotists, psychists, and faith-curers are allowed the full play which has recently been given to them, in infecting the public mind with the follies of the "new hypnotism," the "profound hypnosis," the "new mesmerism," the "magnetization of hypnotics," and the "externalization of sensation," which they have been so solemnly propounding and so profusely describing in the pages of our leading newspapers and serials, we may yet see here an abundant harvest of mentally disordered and pathological creatures, such as have now for some years been permanently on show across the Channel; we may expect also to find our more solid literature poisoned with this evil influence, as our literature of romance and fiction already has been. From what I hear and know of the attractions which these false phenomena, these dangerous tricks, and this practice of mental subordination to another will, are already exercising on some ladies of the upper class in England and on some writers of influence, it appears high time that a thorough exposure should be made of the imposture and the self-deception which underlie the performances. Some of them have been rehearsed before eminent British journalists on their visits to Paris, and by them described in good faith, with no small literary power and considerable although imperfect detail, to the readers of the great English journals. The most vivid descriptions of the modern development of the new superstitions appeared in a series of articles in the Pall Mall Gazette early in last December, and in the Times at the end of December and the beginning of the present year. I was induced thereby to devote a fortnight at the end of the year to an investigation of the facts

described and the phenomena produced, and to an endeavor to find out how they were produced, and, as is always important in an inquiry of the sort, in what sort of people they took place. As a result I was able briefly to affirm in the columns of the Times that I found the whole series of performances to be based upon fraud, and that I had succeeded in reproducing the phenomena without employing any occult means or invoking any new powers of mind or body. This statement was welcomed by persons whose opinion I value, and by many of whom the articles in question had been read, as Prof. Tyndall writes, with "disfavor and indeed dismay." I am urged to lose no time in sweeping away this mass of rubbish, and "the disgusting superstitions" which these letters and publications have tended to promote. This I will attempt to do by stating in some detail precisely what the performances at the Charité are, and removing from them the halo of false science which has rendered them attractive and credible, and has to some extent obscured their demoralizing character. The business of demonstrating the marvels of the new hypnotism has been going on now for upward of twenty years, with very mischievous effects. It has culminated in performances of the patients of Dr. Luys in the wards of one of the greatest and most historically celebrated of the Paris hospitals. The Hospital of La Charité is a hospital with great traditions, dignified by great names, and still the seat of sound and able clinical instruction by a staff who must, I am sure, feel humiliated at finding the name of the great institution to which they belong becoming thus notorious throughout Europe for its connection with proceedings which they can but view with extreme disfavor.

In the first place, two patients were presented (who must be among the patients referred to), for they are and have been for some time the main subjects for demonstration at La Charité. One of these is a man named Mervel, an unhappy being of whom Dr. Luys promised to give me the clinical history, and of whom, briefly, it may be said that he has been all his life a wretched hysteric, subject to fits, to sleep-walking, and to catalepsy. He has passed through all the phases of this form of extreme nerve disorder. If he had been let alone, as he would have been in this country, or treated to a sound course of tonics, cold water (internally and externally), and field labor, he might have lived a more healthy life. He is now a miserable object, trained to all the tricks and the pathological aptitudes for simulation of a highly trained hypnotic, and on him were demonstrated phenomena which might indeed be "marvels" if they were not almost wholly frauds. I will run rapidly over a series of this man's performances as they were shown to me in the wards by Dr. Luys in the presence of observers, and I will presently add some of the other

performances of other patients and trained subjects of Dr. Luys who have differing aptitudes and a various *répertoire*. The man was brought in from the waiting-room and put in an arm-chair; a finger held up before his eyes sufficed to plunge him into induced sleep. This was clearly not simulated, and in a highly trained subject is exceedingly common. The eyelids were then lifted, and a little performance was gone through, which is described in the programme set out in Dr. Luys's Leçons Cliniques as the *prise du regard.* A finger is held before him; he gazes at it, sits bolt upright, and follows it as though fascinated around the room. This is, of course, a very ordinary performance, and is only, so to speak, the *lever de rideau*. He is taken back to his chair, and then begins the second performance. He is shown a magnetic bar, and here the true stage play begins, as it does in so many of these mesmeric performances, with the utterly irrelevant introduction of the apparatus of magnetism. He sees now from one pole of the magnet the "odic" effluvia, the blue flames, which are familiar to the readers of Reichenbach. He is delighted with them; he caresses the bar like a child with a toy; he follows it all over the place, and when the opposite pole of the magnet is presented to him, he is struck with horror at the red flames which issue from it, and shows every sign of fear and disgust. There are infinite variations of this marvel. Thus, a photograph of the poles of a magnet affects him in a similar way, no matter how old the photograph. On the face of Dr. Luys he sees red flames proceeding from the eyes and nostrils on one side of the face and blue flames on the other, which is supposed to coincide with the duality of the nerve-centers of the brain and the opposite polarity of the two sides of the body—puerile deductions which bear upon their face ignorant credulity, but which are supposed to derive evidential strength from these heightenings of the visual perception of this individual and the other performers of the same school. For these subjects quickly learn how to pretend to see the same thing; and Colonel de Rochas d'Aiglun, the *administrateur* of the Polytechnic School in Paris, whom Dr. Luys was good enough to introduce to me, has subjects who have made for him also a considerable series of drawings showing these flames playing about magnets and parts of magnets, surrounding crystals, and irradiating the features of himself and others. One patient has done me the honor of making my portrait with all its magnetic accompaniments. To the heightened visual perception of these ladies and gentlemen it seems that from one side of my face issues a sheet of lambent blue flame, and my eyes dart rays of blue fire; the other side is equally luminous with red flame, while down the middle of my face is a bright streak of yellow. Mervel drew this interesting picture, and the others confirmed it; and as this was done

in the wards of a hospital and by a patient in a state of "lucid somnambulism," and of good faith, I suppose I ought to have assumed that "there was no room for fraud or imposture." I ventured, however, to think otherwise. I took with me on the third occasion a magnet lent me by Dr. Johnson, of London, which had been thoroughly demagnetized by being thrust into the fire, and a series of steel pins which had been variously magnetized in inverse senses, and I found that the heightened senses of Mervel were quite incapable of distinguishing between the inert magnet, the variously magnetized needles, and the true magnet. I even placed the needles and the magnet in the hands of Dr. Luys and asked him to determine what Mervel saw. He saw always, in reply to Dr. Luys's questions, the orthodox thing. I then gently suggested to Dr. Luys that he should try some test experiments and use an electro-magnet, in which he could at will put on and take off the current and try for himself whether the patient did or did not really perceive what he described. I ventured to repeat the same suggestion when Mervel was describing the colored lights he saw around the poles of a faradic machine. My suggestions, however, were not favorably received; and Dr. Luys observed that he must be allowed to make his experiments in his own way. At these sittings Dr. Sajous, Dr. Lutaud, M. Cremière, of St. Petersburg, and others, were present. To end this part of the matter, I should state that I took successively three other subjects of demonstration whom Dr. Luys has presented to his classes, and tested still more decisively their pretended powers of distinguishing emanations from the north and south poles of the magnet and seeing the colored flames of Reichenbach. These subjects were a person named Jeanne, an accomplished impostor, and the most distinguished and highly trained of M. Luys's subjects, whose portrait occurs repeatedly in the illustrations of his lectures, and who describes herself as his *premier sujet*; a person named Clarice, whose marvelous powers are also much described in the publications of Dr. Luys; and a patient now in the wards named Marguerite. I tested these subjects repeatedly in the presence sometimes of the gentlemen above named, sometimes of Dr. Olivier, of Dr. Meurice, and of others whom I need not at present name. The results were that Mervel, whether sent to sleep by Dr. Luys, or by myself, or by the wardsman, was never really asleep to the extent of not being able to gather verbal and visual suggestions as to his course of action, as to what he ought to do and what he ought to see, and that his hysterical or hypnotic slumber did not prevent him from simultaneously carrying on a course of elaborate imposture. When I rapidly displaced the magnetic photographs of Dr. Luys or my own, he blundered over them, but immediately he understood that he was blundering he corrected

his mistake and saw what he ought to have seen. He was quite unable to distinguish an inert piece of iron from a true magnet, and unless he were guided by words let fall by the bystanders, or by the adoption of a systematic proceeding to which he was accustomed, he was quite at sea. Clarice and Jeanne, in their lucid somnambulistic state, never knew whether the current was on or off; unless they had a clew to the answers they ought to give, they were ludicrously wrong. They saw enormous flames issuing from the powerful magnet which I used. When I told the assistant to put on the current, acting on my previous instructions, he always did exactly the opposite of what I said, and they always fell into the trap. The culminating absurdity of this phase of the performance was the famous show for which this *clinique* has become famous, known as the magnetic skullcap, with its therapeutic and physical influences. "In this magnetic circlet," said Dr. Luys (speaking in the presence of his somnambulistic patient, who was supposed not to hear), "are stored up the thoughts and mental characteristics of an individual who suffered from melancholia and hallucinations of persecution. I will now put it on Mervel's head, and you will see what follows"; whereupon Mervel showed dramatic signs of the hallucination of persecution, suffering apparently great pain of mind and body. Possibly it was too cleverly acted to be wholly simulation, but it afforded a good example of the mixture of hysterical readiness to accept any suggestion with unlimited powers of deception; for this took place at the same sitting, and in the same state in which he pretended to see red flames and blue flames at random, accordingly as he supposed the magnet, or the photographs which I showed him, or the prints, or the pins, to be of the north pole or of the south pole. I repeated the experiment, always with the like results. Dr. Olivier, the editor of the Revue des Sciences Physiques, writes to me that the exposure was complete.

There was no correspondence between the phenomena manifested by the hypnotized person and the production of the current of magnetization, etc. You repeated the experiments of Dr. Luys and those of M. de Rochas, avoiding all suggestion, whether involuntary or unconscious, capable of vitiating the results, and you were careful to conceal from the subjects of experiment the moment at which the opening or the closing of the current of the magnet took place.

At any rate, therefore, we may exclude from the positive results which I attained in the presence of many witnesses the possibility of the electrical or magnetic current having any real relation whatever to the phenomena shown, and, as far as the utmost care could go, we may exclude also the influence of suggestion in any occult sense. Where the subjects thought they knew what was expected of them in their state of lucid somnambulism, they did it or saw it, whether I operated, or Dr. Luys, or his ward

assistant. Where they did not know they tried to guess, and with ludicrous results. Habitually they produced results exactly opposite to those which should have occurred, had the magnetic current had any influence whatever as a causal agent. I will now go further, and will affirm that there never was, any more than there now is, the slightest ground for believing that the most powerful magnets are capable of exercising any such influence as Dr. Luys and others are in the habit of assuming that they can exert over the animal organism. Opportunely enough, I find in the New York Medical Journal of the 31st of December a report of the experiments made by F. Peterson and A. E. Kennelly, with the most powerful magnets in the Edison laboratory, of which Mr. Kennelly is the chief electrician. Very powerful electro-magnets of 2,000 to 5,000 C. G. S. units to the square centimetre were employed. Not only was no visible effect produced in the polarization within the magnetic field of the hæmoglobin of blood, or in the circulation in the web of the frog's foot, but when a dog was placed for five hours under the influence of a magnetic field with an intensity of from 1,000 to 2,000 C. G. S. units to the square centimetre the dog was in no way affected and was very lively when liberated. A photograph is given of a boy sitting in a cylinder two feet in diameter and seven inches deep, upon which a set of field magnets converged: he was in no way affected. The next experiments were made by introducing the head into the field of a very powerful electro-magnet (2,000 C. G. S. units). The current could be turned on or off the coils of the electro-magnet without the knowledge of the subject. No effect on consciousness, sensation, circulation, respiration, or tendon reflex could be perceived. The subject was quite unable to say when the current was turned on or off. The last series of experiments were made with an electro-magnet in which the current was reversed two hundred and eighty times a second. No effect whatever was perceived when the head was introduced within the magnetic field of this potent instrument. The authors conclude that the human organism is in no wise appreciably affected by the most powerful magnets known to modern science; that neither direct nor reversed magnetism exerts any perceptible influence upon the iron contained in the blood, upon the circulation, upon ciliary or protoplasmic movements, upon sensory or motor nerves, or upon the brain. The authors further observe that they find it difficult to understand why magnetism appears to have no influence whatever upon the human organism. The experiments of like kind recorded by Sir William Thomson and in Pflüger's Archiv gave equally negative results.

The complete exposure which the results of my experiments effected of the valuelessness of the so-called magnetic effects on

the patients of Dr. Luys tallies with the negative results of Peterson and Kennelly, but it is perhaps too much to hope that it will put an end to the habitual exploitation of magnetic superstitions in this connection.

I come now to another series of phenomena which various eminent journalists have noted as illustrations of what the Times correspondent described as a perfectly genuine exhibition, and one which, as he said, in concluding his description of it, "proved that suggestions and impressions can be conveyed from one person to another by mere contact, and even across an intervening space." As he professes to be an impartial and guarded observer, I will quote his report, which, so far as some obvious occurrences are concerned, describes accurately what appears to go on in the extravagant folly which they have described so seriously, known as "l'envoûtement." This is a title taken from the practices of the middle ages, when the magicians of France and Italy exercised (as the magicians of the far East do now) their powers of sorcery upon a wax image, which, being duly endowed with mystical relationship to a human subject, was pinched, tortured, wasted, or destroyed, with corresponding results to the unhappy individual in whose effigy it was made. Here is the modern counterpart in the new mesmerism of which the modern historian gives the explanation which I have just quoted:

There remains, however, one set of recent experiments, which, from their novel and startling character, deserve special attention. I refer to the transference of sensibility from a hypnotic subject to inanimate objects. I have been fortunate enough to witness some of these experiments, and will describe what I saw. They were not carried out by Dr. Luys, but by an amateur who attends his *clinique.* This gentleman had a roughly constructed figure, about a foot high, resembling the human form, and made of gutta percha or some such material, and he experimented with it on a hysterical young woman, one of the hospital patients, and an extremely sensitive subject. She was placed in an arm-chair and hypnotized, and he seated himself immediately opposite in close contact with her, their legs touching, and her hands upon his knees. After some preliminary business of stroking her arms and so forth, he produced the figure and held it up in front of her, presumably to be charged with her magnetism, for these experiments rest on the magnetic theory. Then he placed it out of her sight and pinched it. Sometimes she appeared to feel it and sometimes she did not, but he was all the time in actual contact with her. Then he held it where she could see it, and this time she *obviously suffered acutely* whenever he touched the figure and in the place where he touched it, although she did not look at it or seem to observe it. Especially when he touched the sole of the foot, it *evidently tickled her beyond endurance.* Then the figure was placed aside on a table out of the sight both of the girl and of the operator, while another put one hand on the operator's back and the other on the image. I was in such a position as to see them all, and whenever the second gentleman touched the figure the girl felt it. Then she was told that she was to feel it just the same after being woke up, and an attempt was made to wake her, but she was by this time very profoundly affected, and the

statement was only partially successful. In this state—that is, still somnambulistic—she stood up and moved from her place, the operator did the same, and, being separated from her by some feet, he turned his back to her and held the figure in such a position that she could not possibly see it. Then he pinched at the back of the neck, and she felt it at the same moment, but at the wrong place. The place where she did feel it caused her some embarrassment, though harmless enough, as she informed him of the locality in a whisper, which I overheard. *I can answer for it that she felt something* at the moment when he touched the image, but that she could not see it and was not in contact with him, because I was standing almost between them. But she felt it far more acutely when he pinched his own wrist under the same circumstances. That brought the experiments to a conclusion. They occupied at least half an hour, and included a number of interesting details which I have been obliged to omit.

Thus his exhibition, which was "perfectly genuine," proved that suggestions and impressions can be "conveyed across space." The fact is that it did not prove the one any more than the other; and if the writer had instituted a few control experiments such as those which I forthwith carried out on the same subject, he would have saved himself from having been the medium of introducing thus impressively to the English reading public, through the pages of a great newspaper, a solemn description of what was easily proved to be a common imposture of a vulgar kind, by which the good faith and unquestionable sincerity and honor of the amateur of whom he speaks, and of Dr. Luys, had been surprised. There is no secret about the name of the amateur, for he has published much about the matter in great detail, with an abundance of highly technical and scientific nomenclature, and the performances had already been described, under his name, in the Pall Mall Gazette in this country, and in La Justice and L'Echo de Paris, and other journals in France. Colonel de Rochas d'Aiglun, who was the operator in this case in the ward of La Charité, gave a similar demonstration for my benefit at the invitation of Dr. Luys in the ward of La Charité in the presence of several witnesses. Subsequently he gave me and Dr. Sajous a like demonstration with fuller developments at the École Polytechnique, of which he is the *administrateur;* and I gave him a counter-demonstration in the rooms of Dr. Sajous before leaving Paris. To appreciate all the details of these performances one should read his book, entitled Les États profonds de l'Hypnose.*

To the subject, Madame Vix, being plunged into "profound hypnosis," as it was alleged, was handed a glass of water. To this she transferred by contact her sensitiveness; the atmosphere

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* Les États profonds de l'Hypnose. Par le Lieutenant-Colonel de Rochas d'Aiglun, Administrateur de l'École Polytechnique. Paris: Chamuel, 29 Rue de Trévise; and G. Carré, 58 Rue St. André-des-Arts, 1892. See also Les Limites de l'Inconnu, by Georges Vitoux. Chamuel, 29 Rue de Trévise, Paris, 1892; and Le Figaro, January 10, 1893, p. 2.

surrounding her was also similarly charged with her sensibility; she herself becoming anæsthetic. When pinches were made in the air at given distances, which were supposed to represent points of contact and lines of cleavage of the atmospheric planes, such pinches at these given points were always felt by her and gave what is above described as "evident pain." I was shown drawings of these planes. When the water was removed to a distance and the glass was stroked or imaginary pinches made in the air just above the water, or the water itself was touched, she gave similar manifestations. This water, we were told, was charged with her vitality, and terrible consequences might ensue if the water were maltreated, either then or subsequently. Fantastic stories are related by Colonel de Rochas of the terrible effects following from the throwing away of this water and from people stepping on it, or from watering the flowers with it. In one case, where some one incautiously drank the water, the patient fell into a swoon which lasted for a fortnight. The only correct proceeding was to allow the subject herself to drink the water at the close of the *séance*, and thus enable her to protect herself from the sad effects which might follow any careless treatment of it. She herself was supposed to be insensitive while under operation, and her sensibilities were externalized and communicated to others either by "contact" directly to the operator, or in another hypnotized patient who was placed in contact with her, or, as the reporter solemnly describes, "across space." Whenever her magnetizer was touched she felt it in the same place.

Now, Madame Vix furnishes *séances* for a fixed consideration. On page 28 of his book on the profound stages of hypnosis, Colonel de Rochas refers to her as being a subject "well known in Paris," "very distinctly polarized," and "who passes with extreme regularity" through all the phases described at length in his first chapter, and, besides, "through some phases of an indeterminate character up to the point of syncope." She presented indeed, "when the left hand was placed on her head instead of the right, general paralysis so closely resembling death in appearance," that he did not dare to continue his experiments. She did the wax-image business, the state of sympathy by contact, and the rest, with such perfection before me under the manipulations of Colonel de Rochas at the Charité and at the Polytechnique School, that I asked her to favor me with some professional sittings, which she readily consented to do. She had an extensive *répertoire,* and on three separate occasions she went through her performances with great precision and completeness in the presence of a variety of witnesses, some of whose names I have already cited. I determined, however, to do everything *en faux*. On the first occasion I solemnly went through all the series of passes and

strokings and head pressure with the right hand, which Colonel de Rochas considers so essential, and we had all the correct successive stages of credulity (or *credivité*), of lethargy, catalepsy, again lethargy, somnambulism, lethargy, and *rapport*, and I then tested the statements of Colonel de Rochas. In the first place I found that in all the phases of the stage of *rapport* the subject perceived other objects and other persons quite as well as the individual, my humble self, who was supposed to be "the magnetizer." When any one pretended to be in contact with me, it had the same effect upon her as if he were really in contact, and it was evident that she guessed at what we were doing. Visions were as easily produced by pressure with the left hand as with the right, and, as to the seeing of colored odic flames from the magnet, she saw them "six yards long"; but, in fact, when proper tests were applied, she was found to be absolutely incapable of distinguishing a true magnet from a false one. She never knew whether the current was on or off my electro-magnet; and her whole performance in this respect, although she was not made aware of it, was so manifest and ludicrous an imposture that the bystanders had great difficulty in retaining their gravity. I tested now the phenomena to which the sham scientific terms of "externalization of sensation," "communication by contact," and "transference across space," are pretentiously applied. Behind a little pile of books on the writing table I concealed a tumbler containing some water. In duly solemn fashion I poured out from a carafe a little water into a similar glass and placed it in her hands. I then quickly substituted, without her perceiving it, the hidden glass of water, which she had neither seen nor touched. We had then a full-dress rehearsal of all the performances which I had previously witnessed. She showed the same "obvious" marks of pleasure or of pain when the water was caressed or pinched as were witnessed by the Times correspondent or the Pall Mall Gazette reporter. When one of the spectators was placed in imaginary contact with me, she became equally sensible of his actions; she writhed, she smiled, she was tickled, she was hurt, she was pleased, and she was "exhausted" in the orthodox manner. I now introduced the "wax figure." Skeptic as I was, but willing to be convinced, I had purchased two rather pretty little sailor dolls, twin brothers of the navy, at a neighboring toy shop. One of these she held until it was sufficiently "charged with her sensitiveness" by contact. I then rapidly substituted the twin doll from my pocket, and put away the sensitivized doll for future service. To make the performance quite regular, I cut off a minute lock of her hair and pretended to affix it to the doll. To this proceeding, which I had seen Colonel de Rochas gravely go through, she rather objected in her profound sleep, much to our quiet amusement. "C'est trop,

c'est trop," she murmured, apparently thinking that I was taking too much hair for the money. I need not say that I did not affix it to the head of the doll, although I went through the motions of doing so. I have now, and shall preserve, the two little doll "witnesses" and the valuable tress of hair as mementos of this interesting performance. It may take its place by the side of the famous tress cut from the locks of the spirit form of Katie King. We then produced, with the aid of the untouched doll, just unrolled from the tissue paper of the toy shop, all the phenomena of the *envoûtement* of the sorcerers, of which so much has been heard lately and which have figured so largely in the pages of the great newspapers of England and France. She felt acutely when its imaginary lock was touched and pulled, whether by myself or by Dr. Sajous, by M. Cremière, or by any one else in the room. She greatly resented its being pricked; she felt all sorts of indescribable and generalized heats and pains when the doll was touched in places of which she could not well make out the locality owing to our backs being turned to her, and she was duly suffocated when we pretended to sit down on the doll. I am ashamed to say that the real doll was lying there all the time, cruelly stabbed by me to the heart with a stout pin, of which she was unconscious. Its maltreatment, which ought theoretically to have been fatal to her, produced no visible effect. These performances she went through three times. On the third occasion Colonel de Rochas was himself present, and assisted to put her into a complete state of hypnosis, for by this time I had become a little indifferent to the stages of preliminary mummery, and, as there were three subjects on hand at the final sitting, I rather abbreviated the proceeding. Colonel de Rochas was a little astonished when I produced my toy-shop doll, clothed in woolen trousers and jacket, for demonstrating the *envoûtement;* but he explained that he was not so surprised as he should have been at an earlier date, for he had only that week observed that in a classic author, where these magical proceedings were described, it was noted that woolen stuff was a very good conductor; and he quoted a passage from a Latin author—of which I am sorry that I do not retain the exact recollection—in evidence of the fact that the woolen dress might prove an effective medium; otherwise, he observed, he should have been doubtful of securing good results, as the doll was of composition and not of wax. It did prove a very good conductor. In the course of the experiment, however, he skeptically tweaked the nose of the little composition doll face (of the doll which had not been "sensitivized"), and we had all of us the satisfaction of observing that the material made no difference to Madame Vix, and that the result was as perfectly satisfactory as if it had been made of real wax, for she immediately exclaimed

that somebody was pulling her nose, and resented it accordingly. At the close of this final *séance*, at which I had invited the presence of Colonel de Rochas, I explained to him the extent of the imposture, and showed him the false glass of water and the twin doll, the sham magnet, and the method which we had pursued in working the electro-magnet under a system of contradictory directions. I may venture to repeat that Colonel de Rochas acted in this, as throughout, as a gentleman of the most perfect good faith. He was duly and adequately impressed with this new order of facts. It is of course impossible to say what may be the conclusions at which he will ultimately arrive, but I understood him to incline to the vague belief that "it was all suggestion."—*Nineteenth Century.*

(*To be continued.*)

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## ADAPTATIONS OF SEEDS AND FRUITS.

By J. W. FOLSOM.

If we consider the great variety of seeds and fruits, we naturally inquire its meaning; and if we are sufficiently interested to observe carefully the part which seeds play in Nature, we soon find that in innumerable ways they are adapted to their surroundings. On the seed, primarily, rests the all-important responsibility of perpetuating the species, and success or failure in this duty depends upon the manner in which the seed is adapted to encounter the dangers that threaten it.

The manifold adaptations of this kind which Nature exhibits have been brought about chiefly by natural selection, resulting from the co-operation of two laws: the law of heredity and the law of variation. Under the former, characteristics of a parent are transmitted to its offspring. In obedience to the latter, no offspring is exactly like its parent, but differs from it more or less. The variation being inherited by the succeeding generation will, if of favorable nature, tend to be perpetuated indefinitely. Contrarily, variation in an unfavorable direction will conduce to extermination of the species from the very nature of the case. Thus it follows that the accumulation of advantageous variations, however slight, and the necessary destruction of species possessing unfriendly characteristics, results in producing kinds well fitted for existence.

Bearing the above in mind as a general explanation, let us consider some of its effects as displayed in seeds and fruits.

We usually find seeds in a seed vessel of some sort, the whole affair constituting the "fruit." Common to all immature fruits is their necessity for protection, and this is met in various ways.

Winds which would break them off are effectually resisted by their strong yet flexible footstalks; and possible injury by bruising is averted by tough, elastic walls, often cushioned by prickles or other appendages.

Sudden changes of temperature, before they can penetrate to the unripe seeds, are rendered harmless by the blanketing effect of pulp or other material.

For protection from the animal world, immature fruits have developed a number of interesting devices. Almost universally "green" fruits so harmonize with surrounding color as readily to escape detection. In fact, the hazelnut is enveloped in a leafy coat which renders it very inconspicuous. The nutritious albumen of the seed is often fortified by such impenetrable shells as those of the cocoanut and others. Perhaps there is a formidable armament of prickles, as in the chestnut; or of stinging hairs, as is the case with some pods. Characteristic of immature fruits are disagreeable taste and consistence. Compare an unripe peach, sour and stringy, with the same fruit in its luscious maturity.

But all these contrivances fail to repel certain enemies of growing fruits. The apple's inconspicuousness, toughness, and sourness are of little avail against the young progeny of the genus *Homo.*

In many remarkable instances plants by their movements are able to protect their precious seeds from injury. In our common fall dandelion the whole flower closes up while the seeds are ripening, but reopens at their maturity. Furthermore, the upright flower stalk sinks to the ground when the flowers fade, but erects itself again when the seeds are ready to be scattered by the wind. In one of our winter house plants, the common cyclamen, the flower stalk coils up after flowering, bringing the pod to the ground to ripen; and our sweet white water lily, after expanding and withering above water, sinks to mature its seeds in safety. Other more remarkable but less common cases might be cited to show the extreme care with which plants preserve their seeds from possible destruction.

At maturity the one object of the seed is to secure the advantages of wide dispersion, and to effect this purpose Nature uses all means at hand. The agencies against which she so lately contrived are now most sedulously sought, and almost endless are the modifications of structure which enable seeds to spread far and wide.

"Dehiscence," the splitting open of a ripe pod, is manifestly a provision for seed dispersion. In its simplest form dehiscence merely exposes seeds to various conveying agencies: to the wind, in the milkweed; to birds, in the case of some brightly colored beans. Other plants, however, do more than this. Our wild

columbine is particularly well adapted for having its seeds scattered by the wind. They are held in open seed vessels surmounting a slender stalk which, although nodding at flowering time, has become upright. A slight breeze easily shakes this stalk, causing the seeds to be thrown for quite a distance. The poppy throws its seeds in a similar way, and the little eaves which stand over the holes in the pod are even said to close in wet weather, not allowing the seeds to escape.

In many wonderful instances the ripe pod projects its seeds forcibly into the air. In some of our wild violets the pod, after dehiscence, consists of three spreading valves, each shaped like a boat, bearing within several seeds which are pear-shaped, hard, and smooth. In drying, the valve walls contract, approach each other, and squeeze out the seeds, which are thus thrown several feet. Our wild witch-hazel throws its seeds often to the distance of thirty feet. Many of us recollect the sudden bursting and coiling up of the pods of the "touch-me-not," whose yellowish, spurred flowers are so common in moist places. The object of this action is to expel the seeds. Curious is the case of the squirting cucumber of southern Europe. The ripe, cucumber-like fruit is greatly distended by its contents. At a slight touch, as from a browsing animal, it breaks from the stalk, and through the hole thus formed the pressure of the elastic walls forces the seeds in a viscid liquid for twenty or thirty feet.

Fruits that do not split open are invariably scattered by external means, inanimate and animate. Of inanimate agencies the wind is far oftenest employed, and seeds have evidently found it extremely efficient, judging from their many adaptations for wind dispersion. The seeds of our elms, maples, pines, etc., are surrounded, as we know, by thin expansions called "wings," whose purpose plainly is to present a large surface for the wind to act upon. Wings are characteristic alone of trees or tall shrubs, and never occur on low herbs, where they would clearly be out of place. Instead of a wing, a tuft of hairs frequently serves the same purpose. A common example is furnished by the milkweed, whose seed is surrounded by a spreading "pappus" of long, silky hairs. The dandelions and thistles have adopted this means of distribution, and this explains their abundance everywhere. In the smoke-bush of our gardens only a few flower stalks bear fruit, the rest become slender and feathery, forming a light network which is borne along in the wind, carrying the few small fruits which have formed.

Flowing water transports many large nuts, some depending upon it almost exclusively. Drifting along in our fresh-water streams one may often see the "key fruits" of the red maple, and the soaking they thus receive must further germination. The

prevalence on our river banks of oaks, hickories, and maples is also very noticeable. Again, ocean currents are of great importance in distributing plants. The cocoanut, buoyed by its loose husk and protected by an impenetrable shell, floats in the sea until it is brought often to some coral island where it may grow. Many small seeds are also conveyed by ocean currents, and it is very probable that they retain their vitality, for Mr. Darwin has recorded some interesting experiments showing that a good proportion of seeds can withstand injury from salt water for a considerable length of time. The action of freezing water, as manifested in frost, has the well-known effect of freeing nuts from their protecting envelopes; and frozen water, in the shape of glaciers and icebergs, is of a little importance in transporting seeds. It is possible that during the Glacial period seeds were conveyed from place to place incased in ice.

Of all devices for dispersion the most remarkable are those by which the aid of animals is secured, and this aid is so valuable that plants spare no expense to obtain it. Usually animals are well paid for their services, but many plants, however, do not hesitate to deceive their benefactors by all sorts of trickery. This latter class, though, has not been nearly as successful as the others in the struggle for existence.

It is now well known that what are popularly called "fruits" exist for the mutual benefit of plants and the lower animals—not for man. And it is generally believed that these fruits have developed their attractive qualities through natural selection. The results reached by man in selecting and propagating the best varieties of fruits are the strongest grounds for thinking that these fruits were once evolved from very crude conditions through similar selection by the lower animals, particularly birds. Such fruits, for instance, as by natural variation became at all agreeable to birds would be sought out by them, to the exclusion of less attractive fruits. In consequence, the favored fruits would stand better chances of setting seeds than would their less favored companions. Variations being transmitted from parent to offspring, it is reasonable to suppose that favorable variations would become still more favorable by further selection, until, by the accumulation of even slight variations through geologic ages, there would result fruits highly attractive to certain animals by their color, perfume, and taste. In the mean time, fruits possessing unfavorable characteristics have for this very reason been exterminated, or else have attained a less degree of success than the others.

Insects are the lowest animals known to assist in seed dissemination. Mr. Darwin tells us of locust excrement containing seeds which grew when planted. Considering that locusts often

occur in vast swarms, they can hardly fail to be highly effective agents in seed dissemination, thus repaying to some extent for the immense damage they often do.

Fishes are known to swallow seeds of many kinds, and must transport them from place to place; but the value of fishes as seed conveyers is hard to estimate.

We have just said that our edible fruits are really contrivances for securing seed dissemination, especially through the agency of birds. Take, for example, some of our common fruits—the currant, grape, plum, peach, apple, etc. All these are constructed with this end in view. When ripe, they are colored brightly to attract animals; some possess agreeable odors, and most have a delicious taste and consistence. In short, they are highly adapted to become the food of animals. While swallowing such food animals can hardly help swallowing seeds as well, and such seeds are finally emitted under conditions admirably conducive to germination. Why our most delicious fruits are often offset by their disagreeable seeds may have occurred to many of us. The fact is, by this means seeds are protected from possible injury in the alimentary canals of animals. Take, for example, the small, hard seeds of the grape or fig, and the similar so-called seeds of the strawberry, blackberry, and others. Far from being destroyed by the digestive juices, the seeds are probably facilitated in their germination by the warmth and moisture received.

The rapid ripening of fruits doubtless prevents their premature destruction. The accompanying change in color is remarkable. Whereas young fruits harmonize completely with surrounding color, mature fruits are extremely conspicuous. Recall the barberry, rose, sumach, mountain ash, and many more. In some honeysuckles each cluster of scarlet berries stands in violent contrast against a green leaf. In the blackberry lily of our gardens the sides of the pod roll back and display their white linings, conspicuously relieving the black, berry-like seeds. The burning-bush is a brilliant example with its flaming scarlet. In the West Indies is a plant whose pods are red within, containing seeds that are blue. Other instances might be named, but they are indefinitely numerous and easily observed by any one.

Many of our fruits are covered with a waxy "bloom" as it is called. This is plainly a protection, for it is commonly known that fruits will long resist decay provided this coating is uninjured. Its probable effect is to resist decomposition by moisture and fungi.

The edible portion, however, is of most interest to us, not only scientifically, but also in a practical way. How highly it is esteemed by some animals may be judged from the expense we often incur in buying fruits out of season.

The use of poisonous fruits is an interesting subject for consideration. How is a plant benefited by producing them?

Mr. Grant Allen suggests with regard to a near relative of our Jack-in-the-pulpit that its brilliant scarlet berries are readily detected and eaten by birds; that such birds are consequently poisoned, and by decaying provide abundant nourishment for the germinating seeds. He adds that birds can not profit by experience and avoid the berries, as no bird ever lives to tell the tale.

At first this explanation seems very reasonable, and perhaps it is; but we have reason for doubting it, for we find that many fruits poisonous to mammals are eaten by birds without the slightest injury. The beautiful apple-like manchineel, which is most virulently poisonous, is eaten by tropical birds with the greatest impunity.

On the whole it seems very likely that some fruits are fatal to other animals but not to birds, and under all explanations poisons are doubtless a protection, at least, to the fruits which possess them.

Many fruits have been so highly cultivated by man that they can no longer set their seeds as originally. Our wild red cherry is a convenient morsel for even small birds; but its highly cultured relatives of the garden must submit their flesh to birds who can not eat stones as well. The case of the strawberry is different, however, for birds can scarcely take a morsel that does not contain numbers of the small, hard "straws," which are really the most essential parts of the plant, for each one incloses a seed.

In many cases Nature economically develops as little sweet pulp as will serve her purpose. In the wild red cherry, for instance, the stone occupies almost the entire fruit, there being only a thin layer of food substance. Often there is none whatever, and instead the fruit attains its ends by simulated attractiveness. The rosary bean temptingly displays its brilliant red seeds, which are in reality of stony hardness. Yet it does not wholly rely upon this artifice, for it is very probable that part of the seeds are scattered by the twisting dehiscence of the tough pod.

In some instances the deception is really wonderful. Some pods and seeds mimic insects so closely as probably to entice insectivorous birds to carry them, at least until the birds find out their mistake. It may be also that this appearance protects them from graminivorous birds. There are pods which curiously resemble worms and spiders and caterpillars. Our common castor-oil bean bears a superficial likeness to a beetle. Yet there are some most remarkable cases of mimicry where beetles are counterfeited in the minutest detail.

Fruits are also disseminated by mammals as well as birds.

Berries are the favorite food of many of our native mammals, the woodchuck and others. Wild apples are frequently carried off by squirrels, and it is well known that squirrels store up large quantities of nuts which oftentimes are never eaten. Fruits too large to be swallowed by most birds are easily devoured by the larger mammals, the apple, for instance, whose seeds are protected by tight husks well adapted to slip through the alimentary canal of an animal without receiving the least injury.

The gourd fruits, so much liked by man here, are equally attractive to his quadrumanal brothers in the tropics.

For utilizing the services particularly of mammals many fruits have developed hooks or horns to catch in the fleece of passing creatures, who thus transport the seeds from place to place. An autumn tramp through our pastures will soon convince one of the efficiency of this mode of dissemination.

A very familiar example of this kind we find in the common burdock; but the hooks of the burdock are insignificant affairs compared with some which exist. In the Southern States grows a fruit, *Martynia proboscidea*, having two recurving horns several inches long. The appearance of the fruit would justify its having an even more formidable name. Another fruit, *Harpagophyton* by name, is a bristling mass of powerful hooks. It is said that lions trying to free themselves from its clutches get it into the mouth and die in torture. Instead of hooks, seeds sometimes effect the same purpose by being sticky.

It is a suggestive fact that hooked fruits occur on low plants, never on trees; also that in geologic time hooks appeared simultaneously with land mammals.

Lastly, we must recollect that man himself disseminates seeds in a thousand ways. War often introduces new plants into a region. Commerce is of vast importance in this respect. In the vicinity of our woolen mills a strange flora, from seeds introduced with the raw wool, is struggling with native plants. Agriculture is certainly of unbounded effect in the way we are considering. In short, human will has almost limitless control over the circumstances of plant life.

After dispersion most seeds simply rest on the ground to await germination, perhaps protected by color resemblance, as in nuts, or by mimicry, sometimes mimicking a dry twig to perfection. Some seeds, though, do more than this. The parasitic seeds of the mistletoe, dropped by birds on the boughs of trees, would soon fall to the ground and die were they not very sticky. The seed of *Mysodendron* has three long, flexible appendages which twine round any suitable branch to which it is blown.

There are a few seeds which literally corkscrew themselves into the ground. One of our natives—*Erodium*, or cranesbill—has

seeds which are small, pointed, and covered with hairs. The posterior end is prolonged into a hairy, corkscrew-like awn, which twists or untwists, according to the amount of moisture. This awn ends in a feather-like affair with backward-pointed hairs. On moist ground the seed-hairs stand out so as to place the seed-point downward, and the awn untwists; but the barbed feather preventing upward movement, because it catches in the herbage, the seed is forced into the soil. However, if the awn dries and contracts, the feather is easily drawn down while the seed is not drawn up. By successive moistenings and dryings the seed is ultimately driven completely into the earth.

As to vitality, seeds present widest differences. Very short-lived seeds are those of the coffee and magnolia. On the other hand, under abnormal conditions, some seeds have retained vitality for many centuries, apparently. Raspberry seeds, found in a Celtic tumulus along with coins of the Emperor Hadrian, germinated, according to good authority, after a possible interval of several centuries. Other seeds from old Roman tombs grew after a lapse of many hundred years, but these are exceptional instances. Accurate experiments show that a few kinds live for fifteen years, or thereabouts, while the majority are much shorter lived. Stories of wheat raised from seed found in mummy wrappings are founded upon no trustworthy evidence whatever.

When a forest has been removed by fire, or otherwise, it commonly happens that a fresh growth of entirely new plants immediately springs up. This may be partly due to the unusual opportunity for growth thus given to foreign seeds; but the usually accepted explanation is that the new growth is from seeds which have long lain dormant.

Finally, as regards germination, seeds accommodate themselves to surrounding conditions with considerable readiness. Some seeds are so tenacious of life as to germinate, not only when old, but also when a large share of their food substance has been destroyed, provided, of course, that the germ itself is uninjured. No seed, however, will germinate without the proper amount of moisture, free oxygen, and warmth, although other disadvantages are often withstood successfully.

We have now described some of the more evident adaptations to surroundings displayed in seeds and fruits, but by no means all; for here, as everywhere else, Nature presents a variety which is almost infinite. Although endless differences in structure are still unexplained, we must believe that they are adaptations to circumstances present or past, and our knowledge leads us confidently to expect that future discovery will reveal in increased vastness the complexity of the relations by which everything in Nature is adapted, more or less perfectly, to everything else.

# WHY GROW OLD?

By Dr. N. E. YORKE-DAVIES.

It may seem a curious assertion to make, but it is nevertheless an absolutely true one, namely, that a man's life is not measured by the years that he has lived, but by the way in which he has spent them. Many a person may be as young and active at seventy as another at twenty-five, and the length of his life, his health, and his ability to enjoy green old age, depend in a great measure on what the surroundings have been in the earlier years of existence. It is perfectly true that every one may not be born with a strong and healthy constitution. There are certain constitutional defects that are hereditary in certain families, and these under certain circumstances may influence length of life. For instance, we may inherit the scrofulous taint and fall victims, if not careful, in early life to consumption. We may inherit the gouty taint, and be subject to all the ills that this disease entails in middle age in those who do not learn how to diet themselves. We may be born of families in whom the tendency to obesity is more than usually developed, and this in advancing life may be a serious drawback to comfort, and will undoubtedly tend to shorten existence. But all these weaknesses and idiosyncrasies of inherited constitution may be wonderfully improved, and even, eventually, entirely remedied, if in early life proper care in regard to exercise, food, fresh air, and those surroundings which tend to strengthen the system and improve constitutional stamina, are made a part of the daily routine.

A boy or a girl should be trained to indulge in athletic exercises of some kind, so that the habit of taking exercise may become established, and this, once acquired, is seldom neglected even as years advance. The boy who is fond of football, cricket, tennis, and other athletic games will, from the simple love of emulation, always keep up his muscular and nervous strength, and this will stand him in good stead in middle age, and even in a greater degree in old age.

In a former article in this magazine I gave some statistics with regard to the after career of university men, and those statistics proved that their lives were longer than those of others who in college life were of a more sedentary habit. That is, they lived and are living to beyond the average duration of life at any given age. Some who have come to me of late, to remedy by dietetic means—the only means I adopt—the tendency to obesity or gout, have been fine specimens of physique.

We all know that a seed planted, whether it be a grain of wheat or an acorn, depends for its proper development upon care-

ful manuring and proper attention in its early existence, as to whether it becomes a strong plant or dies in its infancy. If it is planted in congenial soil, and is properly watered and cared for, it will live and grow luxuriantly; but if in improper soil, and left to take care of itself, it will possibly soon die. It is the same with a human being, and however weakly it may be as an infant, if it is properly nursed and taken care of, the foundation is often laid of a mature and sound constitution.

The law of the survival of the fittest may, in some instances, be a cruel one; but it is a beneficent one, for it does not seem right that those entering the world should be handicapped with the weaknesses of their ancestors, and those who have the well-being of the race at heart hold the opinion that constitutions that inherit any strongly marked hereditary weakness should not be allowed to contract obligations that may and will entail suffering upon a future generation.

We do not attempt to rear plants and flowers from imperfect specimens, nor does the agriculturist breed his stock from any but the best and healthiest in any class that he may wish to propagate, and surely the same amount of care and selection should be used with regard to our own species. In the higher ranks of life we see better specimens of the English race than in the lower ones, for more care is exercised in this respect. Something more, of course, must be allowed for this greater care and attention bestowed up to adolescence. Whereas it is estimated that out of every million people born, only ninety thousand reach the age of eighty, eleven thousand that of ninety, and two thousand the age of ninety-five—really, treble that number should reach these respective ages; in fact, if all the surroundings of life in every way were as they should be, there is no reason why six times the number should not reach these ages.

Much of the comfort of middle and old age depends upon early training and early feeding, and I refer here more particularly to school life. Neither mind nor body should be *forced*. While the intellectual faculties are being trained, the bodily requirements should be attended to. The constitution is being built up during the years that a boy is being educated for his pursuits in after life. I can remember my own life at a well-known school in a fashionable town five-and-thirty years ago, and I often wonder I survived it when I recall many circumstances. No proper care was taken of us; hunger, thirst, badly cooked meat and vegetables, sanitary defects, were the rule. Many a time, hungry as a schoolboy should be, have I had put before me for dinner meat that was scarcely warmed outside, and this or nothing had to be my meal. Had it not been for an old man who used to come to the playground selling buns and cakes, I do not know how at

times we should have endured the pangs of hunger, or subsisted on the scanty fare allowed, even had it been properly cooked, which it seldom was. Fortunately, nowadays, I believe, the *cuisine* in public schools is much improved, and more care is taken that growing boys should have a sufficiency of those foods that lay the foundations of a sound constitution in after life. A parent would do well, before sending his progeny to school, to see that the ventilation of the rooms, the sanitary arrangements of the school, and the diet and the capabilities for gymnastics and outdoor exercise are adequate. These things are of as much, if not of more, importance than the knowledge of Greek and dead languages, etc. There is every reason why, while the intellectual faculties are being trained, proper care should be taken of the material part; in fact, a boy's mind can not be stored with information which may be useful to him in after life and the health maintained at a standard to resist disease, if, at the same time, the brain is not fed by proper food, and the constitutional stamina kept up by exercise and fresh air.

There are some diseases due to carelessness in early life that leave traces that may handicap their possessor throughout existence, and possibly the worst of all is rheumatic fever. In this case, mischief may be done to the heart that can never be remedied, and therefore it is necessary in the days of adolescence, when the individual is careless of consequences, that a boy or a girl should be properly clad, and more especially that the covering next the skin should be flannel. The tendency that rapid changes of temperature have to induce this disease where an individual inherits the gouty and rheumatic diathesis, should make its prevention a matter of great importance, and much may be done by forethought and care to obviate the risk. Another result of school life that may bear bitter fruit in after life, that never seems to have attracted the attention it should do, is that the weak and the strong are allotted the same amount of intellectual work. This should not be. "The wind should be tempered to the shorn lamb," and the amount of intellectual work of each boy should bear some proportion to his physical and mental power.

Of course, it would be useless to expect the young to apply to themselves rules that bear fruit when they get to middle and old age. They are too young to have forethought and to understand that, like a bottle of new port, they ought to carefully mature, so as to improve as time goes on. It is a melancholy circumstance, as I have seen even recently, a lad, unfortunately left with boundless wealth and a great name, beginning life at seventeen years of age, and becoming a prematurely old man at twenty-four, and there are few medical men of large experience who can not recall numerous instances of men who have overdrawn their con-

stitutional bank before the age of twenty to such an extent that the account can never be placed on the right side on this side the grave.

If I were asked what factors would conduce to green old age, and the ability to enjoy life to past the eighties, I should say it was a matter of plenty of good food, fresh air, and exercise in early life. But, alas! how few people take the trouble to consider for one moment what food would be most suitable for their particular requirements, or the requirements of their children, at a time when this is all-important! We can not put old heads on young shoulders, but we can suggest to those who have young lives in their charge that they have a serious trust, and what their duty is in this respect.

We know that meat and bread furnish all that is necessary to sustain life, but, of course, we do not live on meat and bread alone. The ordinary living is made up of thousands of different articles in daily use. Still, there are certain rules that particularly apply in this way, that certain constitutions require a larger proportion of one particular class of food than other constitutions, and the man who does a large amount of physical labor requires a different mode of dieting from one who is sedentary. It would be impossible to enter into a subject of this kind at length in a short article. Diet, however, undoubtedly has much to do with long life, and this more especially applies in its application to the particular calling of each individual. The engine of an express train is coaled differently from that of a slow one. A race-horse is fed and exercised differently from a cart-horse, etc.

A man brought up in an active occupation that entails a certain amount of muscular exercise can take an amount of food that a man of sedentary habits would not stand, and therefore a certain difference should be made in the composition of the diet taken by the two. Food is simply fuel, and in a general way answers the same purpose.

As Dr. B. W. Richardson, in his interesting work, Diseases of Modern Life, observes: "The English middle class, who may be exhibited as types of comfortable people, moderately provided for, take on an average twelve ounces of mixed solid food for breakfast, twelve ounces for midday meal, or luncheon, and from twenty to thirty ounces for their late modern dinner or ancient supper. A total of from forty-five to fifty ounces of solid sustenance is in fact taken, to which is added from fifty to sixty ounces of fluid in the way of tea, coffee, water, beer, wine. This excess is at least double the quantity required for the sustainment of their mental and bodily labor."

He then gives a good illustration of this, and says: "I was once consulted in respect to the symptoms with which the idle in-

mates of a large and wealthy establishment suffered. I was told that an affection very much like dysentery had become developed, and was unusually obstinate of cure. The water supply of the establishment, the drainage, the ventilation, had all in turn been blamed, and altered to no effect. I found the unfortunate sufferers were sitting down regularly to four heavy meals a day, with animal food at each meal; that they took between meals no exercise adequate for utilizing a little of the potential energy that was stowed up in their tightly packed organisms.

"This one fact seemed to me sufficient to account for the phenomenon, and the instant relief that followed the cruel prescription of 'double the work and halve the food' was proof direct that the process of cure was immediate."

This quotation I reproduce as illustrating what I have pointed out, that the amount of food should be adapted to the requirements of the system, and to the amount of physical or intellectual work done, if it is not to be harmful in some way. If these individuals had been huntsmen or whippers-in to a pack of hounds, the food would probably have been just sufficient for the requirements of the system. If we want to see good illustrations of green old age, we must look for it in men who are noted for their physical and intellectual vigor; and a man who takes active exercise, whether in cutting down trees or in brisk walking and other physical pursuits, and in addition to this does plenty of brain work, lives carefully, and drinks but very moderately, may, long after he is an octogenarian, control the destinies of a mighty nation, and give indications of mental and bodily vigor that would shame many half his age. The wiry frame of such a man will be vigorous when the obese and sedentary individual of the same age has drifted into senility and second childhood.

There is no more fatal barrier to long life than obtains in the case of a man who has until middle age been used to active occupation, and been employed in business pursuits that have engrossed his time and energies, and then suddenly retires to a life of ease, luxury, and enjoyment. The revulsion that such a change entails seems to throw the whole human machine out of gear. The surroundings in the way of diet and exercise are seldom considered and adapted to the altered circumstances, and the result is that the different organs that looked to the stimulation of active occupation to keep them in working order, become clogged with waste; and those diseases that depend upon such a state of affairs, such as congested liver, indigestion, obesity, gout, bronchial troubles, etc., soon manifest themselves. Does not this equally apply to any piece of mechanism? Even take a clock, for instance; if dust, rust, and dirt are allowed to accumulate in its working parts, how soon (be its steel ever so highly tempered) does the friction

of adventitious matter throw its harmony of movement out of order!

Work of some kind or another seems essential to the well-being of the human organism. Even a machine keeps in better order when it is worked, looked after, and oiled, than when it is neglected and allowed to rust. Up to middle age persons may indulge in any amount of hard physical exercise—that is, if they are wiry and of proper physical proportion; but if a tendency to corpulency supervenes, certain changes in the blood-vessels and other organs, on whose healthy action robust health depends, take place. These become weakened and altered in texture, so that any attempt at undue exercise is attended with a certain amount of risk. Hence, any one who wishes to live to old age, and enjoy it, should look with anxiety at the first indication of corpulency. How many patients have consulted me to whom I have pointed out personally, or by correspondence, that they have carried for years an unnecessary burden in the way of surplus weight; and after, by proper dietic treatment, they have been relieved of it, with improvement in health and condition, they have regretted that for so many years they should have been weighted with a useless and uncomfortable load.

Of course, the tendency to corpulency is a very common one, and I know of no condition that tends to shorten life and to make it more of a misery, especially as years advance. The extra work of carrying unnecessary fat entailed on the heart alone is quite sufficient to shorten life; but, worse than this even, it lays the system more open to congestive diseases, and less able to bear treatment for their cure. It is the greatest bar to enjoyable old age. I suppose my experience of this condition is exceptional, as I devote the whole of my professional time to remedying it and a few other diseases of malnutrition, by a system of scientific dieting now well known. As this condition is the result of taking certain foods in undue proportions, its remedy lies in properly apportioning these; and as soon as those who unduly increase in weight are taught what the injurious ingredients of their daily diet are, and advised to curtail them for a time, the result is that they lose unnecessary tissue rapidly and safely, with improvement in every way.

For a month or two the daily intake of food and its constituents must be carefully adjusted. No purgative or other medicine is necessary for the purpose; indeed, violent purgative medicines are absolutely injurious, as they simply wash the food through, without giving it time to nourish the system, and debility, palpitation of the heart, and loss of condition result. Of course, a little mild aperient, in the shape of some natural mineral water, such as the Franz Josef, is always harmless, and most people,

from errors in diet, require something of this kind occasionally. Electrical appliances and electric baths are quite useless as fat-reducing agents. Quack remedies of all descriptions should be avoided like poison; if they reduce weight they do it at the expense of health. Of this I have seen repeated examples, and this induces me more particularly to make these observations.

The meager diet and quantity of water drunk at some of the spas abroad, of course, clears the system of waste; but this is only a temporary benefit, as the individual is not taught what little alteration he should permanently make in his diet. He comes home to his luxurious surroundings, and rapidly recharges the system with fat, gout poison, and other injurious products that form the elements of certain food which he takes in too great excess.

Exercise, proper selection in diet, and a little abstinence are better means of warding off an attack of gout than all the spas in existence, and the symptoms of an impending attack are well known to sufferers. As soon as the system is overcharged with the poison, an acute attack comes on. How much better to prevent the system being charged at all with an unnecessary poison, and this is only to be done by a proper selection in diet! Hard-worked laborers and the poor never suffer from gout, and the Scotch are entirely free. It is a disease of overfeeding—more especially in certain articles of food and drink—and underworking, and entails on its victim much misery, if not worse, and his progeny inherit the curse for generations after.

The evils that arise from errors in diet are properly remedied by diet. An excess of fat invariably depends upon the individual indulging to too great an extent in sweets and farinaceous food, and in not taking sufficient exercise to work it off. The surplus in such a case becomes stored in the system as fat, and can easily, as previously pointed out, be got rid of by a properly constructed dietary. This may be very liberal indeed, but all fat-forming ingredients must be carefully cut off. I have known twenty-five pounds of fat lost in a month by dietetic means alone, with vast improvement in the general health and condition. Indeed, a loss of surplus fat always means a great improvement in condition as well as in activity and vigor.*

Different constitutions have peculiarities in regard to the way in which they assimilate food, and the old adage that what is one man's meat is another's poison is a very true one. There is no ailment more common in middle life and in old age than indigestion. This, of course, depends upon improper food taken too frequently

* See Foods for the Fat: the Dietetic Cure of Corpulency, by Dr. Yorke-Davies. London: Chatto & Windus.

and in undue quantity. As a rule, the victim of indigestion flies to medicines for relief, or to one of the thousand-and-one quack remedies that are advertised to cure everything.

How much more rational would it not be to alter the diet, and to give the stomach the food for which it is craving! If the stomach could talk, I can imagine it, after pills, and gin and bitters, and quack remedies of every description have been poured into it, begging to be relieved of such horrors, and saying, "Give me a little rest, and a cup of beef tea and a biscuit, and go and take a little fresh air and exercise yourself." Instead of this, the miserable organ has to be dosed with all sorts of horrible concoctions in the way of drugs, brandies and sodas, and champagne, to endeavor to stimulate it into action. There is no doubt that the stomach that requires stimulants and potions to enable it to act efficiently, can hardly be said to be in a healthy state, or can long continue to do its work properly.

The digestive organs, unfortunately, are the first to sympathize with any mental worry. They are like a barometer, and indicate the errors of malnutrition and their consequences. The healthy action of every organ depends upon the proper assimilation of the food taken. As soon as the digestive process fails, everything fails, and ill-health results with all its disastrous concomitants.

Indigestion is more particularly the ailment of those engaged in sedentary pursuits, and if a person who is frequently the victim of it would, instead of flying to drugs, try such a diet as the following for a few days, he would not regret doing so. At least, this is my experience:

He should begin the day at 7 A. M. with a tumbler of milk and soda water, or a cup of Liebig's beef tea, or of bovril. At half past seven he should take a tepid or cold sponge bath and rub the skin thoroughly with a coarse towel or, better still, before the bath, with a massage rubber. At half past eight for his breakfast, one or two cups of weak tea, with a little milk and no sugar. A little stale bread or dry toast. A grilled sole or whiting, or the lean of an underdone mutton chop, or a newly laid egg lightly boiled. For luncheon at one, a few oysters and a cut of a loin of mutton, some chicken or game, or any other light digestible meat. A little stale bread and a glass of dry sherry or moselle. Such a one should avoid afternoon tea as he would poison, and at six or seven have his dinner, which should consist of plainly cooked fish, mutton, venison, chicken, grouse, partridge, hare, pheasant, tripe boiled in milk, sweetbread, lamb, roast beef, and stale bread. French beans, cauliflower, asparagus, vegetable marrow, or sea kale, may be used as vegetable, and half a wineglassful of cognac in water may be drunk. If he takes wine, one or two glasses of

dry sherry after dinner, and before retiring to bed a cup of Liebig's beef tea and a biscuit may be taken.

During the day brisk walking exercise to an extent short of fatigue should be indulged in, or riding or cycling, as the case may be.

Such an individual in a few days would find himself a different person. Slight ailments of this kind, and errors of malnutrition, are much better treated by diet than by medicine. Of course, there are certain habits that are not conducive to long life, such as immoderate indulgence in the passions, whatever they may be, and the abuse of alcohol. There is no reason why a man should not enjoy, in moderation, all the good things of this life, and really the enjoyment of them means taking them in moderation. The man who enjoys wine is the man who takes just sufficient to do him good, and the man who drinks wine to excess, and suffers the next morning from headache as a consequence, can not be said to do so. Excess in alcoholic stimulants in early life means sowing seeds that will bear bitter fruit in mature age —if the individual lives to see it. The habit of "nipping" is conducive to shortening life more than any other habit. It stimulates the different organs of the body into unnatural activity, and the result is that certain of them, such as the liver and the heart, by the work thrown upon them, become, through the enlargement and engorgement of their tissues with blood, diseased after a time. This leads to their being useless as organs of elimination or of healthy structure, with the result that, when middle age is just over, the individual becomes prone to such complaints as Bright's disease, dropsy, cirrhosis of the liver, and other vital indications of decay. These habits are acquired in early life. The wind is sown then and the whirlwind is reaped later on. It is seldom that the young will learn the importance of, if I may so express it, training for old age, but there are exceptions to this rule. Only a few days ago a man came to consult me; he belonged to the luxurious classes, and, though only twenty-three years of age, seemed to have the forethought of a man of sixty. A fine, handsome young fellow of nearly six feet, he said to me: "Doctor, as most of my family have died young through becoming excessively fat, I want to know what I am to do to avoid this. I am already heavier than I should be." Now, a man in the full enjoyment of health and bodily vigor, who had so much foresight, and who wished to learn the means of attaining green old age, which he saw would be sapped by a hereditary tendency to obesity, undoubtedly deserves to do so, especially as the particular condition that he dreads can be so easily benefited without debarring him almost every luxury within his reach.

If more people followed this example, how many years longer

would the average life be, and how much more pleasant would life become! One of the greatest barriers to the enjoyment of life in old age is the condition that this young man dreaded; and my experience is that the food of old people is by no means always what it is wise for them to take. It seems to be the general opinion that old people should be always eating, that they should be stuffed, and that farinaceous food is what they should principally take. This, every one knows, tends to develop corpulency, which is, as I have explained, a most undesirable condition.

I find that if old people are put on a good meat diet in the way of strong soup, beef tea, and animal food, and only just sufficient farinaceous food and fats and sugar to maintain the heat of the body, they increase wonderfully in energy and, as they often express it, feel twenty years younger. This is only natural; it is a food of energy; the food that builds up muscle, nerve, and constitutional stamina.

The requirements of the system in old age, as a rule, are not very great, and more harm is done by taking too much food than by taking too little. I have known people considerably over seventy derive the greatest benefit from a thorough change in diet. It seems to rejuvenate them. Of course, in old age care should be taken that the body is not subjected to rapid changes of temperature. When the nervous power is decreasing as the result of age, and the system is losing the power of combating cold and strain upon its energy, a stimulating diet invigorates, and is conducive to maintaining constitutional stamina better than any other.

Any natural death but from old age and general decay is an accidental death; that is, it is due to causes which might, and even perhaps could, have been entirely avoided and remedied in earlier years. But, of course, all the secrets of attaining extreme age are not even now within our reach, and the few that I have pointed out are but a very few, and those of the commonest. It is the inevitable law of Nature that we must die. The vital energy that is implanted in the body at birth is only meant to sustain it for a certain number of years. It may be husbanded or wasted, made to burn slowly or rapidly. It is like the oil in a lamp, and may be burned out to little effect in a little time, or carefully husbanded and preserved, and thus made to last longer and burn brighter. It is a moot question whether every individual is not at birth gifted with the same amount of vital energy and of life-sustaining power. The probability is that each is. The circumstances of the environment from the cradle to the grave determine its future destiny.

It is a well-known fact that half of the infants born in certain

crowded streets in Liverpool die before they arrive at the age of one year, whereas, under ordinary or healthy surroundings, a half would not die within the first five years of life. Why is this so? Simply because the surroundings are so detrimental to healthy development. Again, consumption is fatal to sixty thousand people in England alone, annually, and this is a disease born of hereditary taint, due to unhealthy surroundings and other health-depressing influences. In fact, as I have before said, most of the diseases which destroy in early life are due to causes which ought not to exist, and in time, as sanitary science advances, will not exist. We know that already the improved sanitation of the country is bearing fruit, that the average life is lengthening year by year, that many diseases that carried off tens of thousands in the days of our grandfathers are almost harmless now.

Smallpox has lost its terrors. The causes of such fatal diseases as typhoid, diphtheria, etc., are well established, and doubtless, in time, these plagues will be rooted out.

Last year we escaped an epidemic that might have carried off hundreds of thousands, and why? Because we know its ways, and have not allowed it to spread in the country. The highest duty of the state is to guard the health of the people, and public opinion of recent years is waking up to this fact. An epidemic is no respecter of persons; it may have its origin in the hovel of a pauper, but its baneful influence reaches the lordly palace of the noble, and it ingulfs all classes in its deadly embrace. The aristocrat and the plebeian are socially separated by a very wide gulf, but as far as epidemic disease goes they are conterminous. Social distinctions are no barrier when the angel of death is following in the wake of those plagues that destroy life before its natural termination in old age and general decay.

To sum up, if old age is to be put off to its furthest limits, the individual who wishes to attain it should live carefully up to middle age, taking plenty of exercise, and so adapting the diet that corpulency, gout, and other diseases due to taking too much and improper food without doing sufficient physical work to consume it, can not be developed. Mental and physical occupation are an absolute necessity, if the constitution is to be kept in healthy working order, and this applies equally to both sexes. The human economy will rust out before it will wear out, and there are more killed by idleness than by hard work. Human energy must have some outlet, and if that outlet is not work of some kind, habits are acquired that are not always conducive to long life.

Old age is the proper termination of human life, and, as Cicero says: "The happiest ending is when, with intellect unimpaired, and the other senses uninjured, the same Nature which put to-

gether the several parts of the machine takes her own work to pieces. As the person who has built a ship or a house likewise takes it down with the greatest ease, so the same Nature which glued together the human machine takes it asunder most skillfully."

Death by extreme old age may be considered the desirable end of a long-continued and at times weary journey. The pilgrim begins it in infancy, full of hope and life; continues it through adolescence in its roseate hue; and onward until middle age, with its cares and anxieties, begins to dispel the illusion. Then comes the time of life when vitality begins to decline, and the body to lose its capacity for enjoyment; then comes the desire for rest, the feeling that foreshadows the great change; and if this occurs in extreme age, the sufferer seems to fall asleep, as he might do after severe fatigue.

So the long and, in many cases, the weary pilgrimage of life is brought to a close with little apparent derangement of mental powers; the final scene may be short and painless, and the phenomena of dying almost imperceptible. The senses fail as if sleep were about to intervene, the perception becomes gradually more and more obtuse, and by degrees the aged man seems to pass into his final slumber.

In such an end the stock of nerve-power is exhausted—the marvelous and unseen essence, that hidden mystery, that man with all his powers of reasoning, that physiology with all the aid that science has lent it, and the genius of six thousand years, has failed to fathom. In that hour is solved that secret, the mystery of which is only revealed when the Book of Life is closed forever. Then, we may hope, when Nature draws the veil over the eye that is glazing on this world, at that same moment she is opening to some unseen but spiritual eye a vista, the confines of which are only wrapped by the everlasting and immeasurable bounds of eternity.—*The Gentleman's Magazine.*

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G. A. LEBORET, writing of the late disaster at St. Gervais, Switzerland, from the breaking of a glacial dam, and recalling other stupendous calamities of like character, charges British geologists, living in a country where Nature's moods are mild, with being too averse to admitting cataclysmal phenomena and of being disposed unconsciously to belittle and almost ignore the occasional violent action of the various rock-destroyers. With such catastrophes in mind as have occurred several times in the Alps, of which that of St. Gervais is only one specimen; with the flood in the Indus in 1835, beside which these sink into insignificance—and not forgetting our Johnstown flood—one must hesitate before assigning too uniform a degree of intensity to the various agents of denudation; nor can one easily avoid the conclusion that, as regards some of them, their rate of work was occasionally far greater in past than in present times.

## CHILDREN'S QUESTIONS.

MY little daughter is sitting very quietly on the floor beside me, busily engaged in arranging her colored house blocks in streets and lanes. She seems so completely absorbed in her play that I am careful not to speak to her, or even to look at her, lest I should disturb her. Suddenly, however, she drops her little houses and, looking earnestly at me with her blue eyes, she asks:

"Mother, does everybody die?"

"Yes, dear; everybody," I answer, struck by her question.

"The very good ones too?" she questions on timidly.

"Yes, the good ones too. God takes them to him because he loves them, and wants them to be with him in his beautiful heaven."

For a while the little one remains quiet; then again, coming up and nestling at my side, she says:

"Mother, wouldn't it be all the same to the loving God if he didn't take me into heaven, but left me always here with you?"

Drawing her closer to me, I try by caresses and loving words to calm all the doubts of her little heart. She is in an inquiring mood, however, and shortly begins anew:

"Mother, does the angel who brings the little babies carry them in a box or just in his hand?"

Unprepared for this question, I answer hesitatingly, "No, not in a box."

"But they have dresses on, haven't they?"

"No, darling, the little babies come naked into this world."

"But then, mother, how can the parents tell whether it is a girl or a boy?"

Once more I am at a loss, but make out to say, "Oh, we see that in their faces."

The little one is satisfied for the moment, for she turns again to her toys. Suddenly an idea strikes her. "Mother, father said the other day that I had the face of a boy. Perhaps I am not a girl at all." This time I can answer without hesitation: "No, dear, you are certainly mother's own dear little girl. But now don't ask any more questions, but come and help me to bake in the kitchen."

The child is quite content to do as I say, and, following me, devotes her mind with as much seriousness to the cooking, or rather to watching it, as she had before shown in trying to arrive at the origin of mankind. Truly, there is something wonderful in the growing mind of a child. The world and life are full of insoluble problems for the adult understanding, but to the mind of a child every new phase of things comes as a riddle and a mystery. What

wonder, therefore, if in their struggle for knowledge, and the efforts they make to learn from the experience of their elders, their whole being becomes, as it were, one big, interminable question!

At times, of course, it can not be denied, the questions become irksome, but who would wish a child to ask no questions? Julius Sturm tells, in one of his pretty fairy tales, how a grandfather, driven into impatience by the constant questionings of his grandchild, exclaimed, "I wish your tongue were out of joint!" but when, unexpectedly, his wish was fulfilled, and the child became dumb, how he joyfully exchanged one of the two years which an angel had prophesied he was yet to live for the privilege of hearing the little one's prattle again.

A child whose questions are not answered by its parents will either turn to others who are willing to gratify its desire for knowledge, but who perhaps are unable to distinguish between what is good for a child to know and what is not, or else it will lose its fine natural susceptibility, and learn to look upon life in a dull, spiritless way, without interest or curiosity. Worse, however, than not answering a child's questions is to ridicule them. Nothing wounds a child so deeply as finding its inexperience abused and its earnestly-meant questions made the subject of mockery. How common a thing it is to hear a child's question impatiently and even contemptuously condemned as "silly"! Yet, in most cases of the kind, the silliness is not with the child, but with the older person who fails to understand how a child's mind works. Every child has involuntarily a feeling of distrust for grown-up people, which is only expelled through trust in the love of its parents. This trust once thoughtlessly abused and shaken may perhaps never be restored to its original purity and strength; and who could have the heart deliberately to impair such sweet confidence?

It is true children sometimes ask questions which it is not easy to answer, at least not in the short, simple form suited to the mind of the questioner. For example:

"Do the little sparrows know they are sparrows?"

"Do animals go to heaven, too?"

"Can God do everything?"

"Can he make my birthday come twice in one year?"

Or, again:

"Why does the fire burn?"

"Why is ice cold?"

To answer such questions may baffle our knowledge, but we should at least make an honest and patient effort to say something helpful. If we can not give all the light we could wish, we can at least give sympathy and encouragement.—*Translated for The Popular Science Monthly from the German, by F. M. J.*

# EAST CENTRAL AFRICAN CUSTOMS.

By JAMES MACDONALD.

## PART II.

AN institution peculiar to Central Africa is the prophetess,* who combines with her prophetic functions the office of witch detective. As she is the most terrible character met with in village life, a detailed account of her office and method of procedure may be interesting. It is to the prophetess the gods or ancestral spirits make known their will. This they do by direct appearance, and in dreams or visions. The prophetess, who is frequently the chief's free wife, dreams her dreams and then gives forth oracles at intervals, according to the exigencies of the case. These are generally delivered in a kind of hysterical frenzy. When she sees the gods face to face, which always happens at the dead hour of night, she begins by raving and screaming. This she continues till the whole village is astir, and she herself utterly prostrated by her exertions. She then throws herself on the ground, and remains in a state of catalepsy for some time, while the villagers gather round her, awe-stricken, waiting for her revelations. At last she speaks, and her words are accepted without question as the oracles of God. Has she not seen the ancestors face to face? Has she not heard their voice sending a message to their children? Is she not their friend, to whom they have shown favor? Must not all hear the words of those who have gone before?

After these revelations, the prophetess may impose impossible tasks on men, and they will be attempted without question. She may order human sacrifices, and no one will deny her victims. Suppose she, for any reason, declares that a person must be offered in sacrifice to a mountain deity—for there are gods of the valleys and gods of the hills, deities of the rivers and of the forests—the victim is conducted to a spot indicated by her, and bound hand and foot to a tree. If during the first night he is killed by beasts of prey, the gods have accepted the sacrifice, and feast "on his fat," which is "as the smell of spices in their nostrils." Should the victim not be devoured, he is left to die of starvation, or is thrown into lake or river with a sinker attached. "The slave was not worthy of the god's acceptance. He is worth nothing to any one." Fowls and other animals killed in sacrifice are not burned; they are simply left near the "prayer tree," and when devoured during the night the sacrifice is accepted. Among the tribes

* Walolo tribe and Lake Shirwa district generally.

farther south, animals sacrificed are cooked and eaten, with the exception of the sacred portions, which are burned with fire.

As a detective of wizards and witches, the prophetess is in constant demand. When traveling on official duty in this capacity, she goes accompanied by a strong guard, and when she orders a meeting of a clan or tribe, attendance is compulsory on pain of confessed guilt. When all are assembled, our friend, who is clad with a scanty loin-cloth of leopard skin, and literally covered from head to foot with rattles and fantasies, rushes about among the crowd. She shouts and rants and raves in the most frantic manner, after which, assuming a calm, judicial aspect, she goes from one to another, touching each person's hand. As she touches the hand of the bewitcher she starts back with a loud shriek, and yells: "This is he, the murderer; blood is in his hand!" I am not certain if the accused has a right to demand the *mwai*, but it appears this may be allowed. My impression is that the law does not require it, and that the prophetess's verdict is absolute and final. The condemned man is put to death, witchcraft being a capital crime in all parts of Africa. But the accuser is not content with simply discovering the culprit. She proves his guilt. This she does by "smelling out"—finding—the "horns" he used in the prosecution of the unlawful art. These are generally the horns of a small species of antelope, and which are *par excellence* "witch's horns." The prophetess "smells out" the horns by going along the bank of a stream, carrying a water vessel and an ordinary hoe. At intervals she lifts water from the stream, which she pours upon the ground, and then stoops to listen. She hears subterranean voices directing her to the wizard's hiding place, at which, when she arrives, she begins to dig with her hoe, muttering incantations the while, and there she finds the horns deposited near the stream to poison the water drunk by the person to be bewitched. As they are dug from the ground, should any one, not a magician, touch them, even accidentally, the result would be instant death.

Now, how does the detective find the horns? By what devil's art does she hit upon the spot where they are concealed? The explanation is very simple. Wherever she is employed she must spend a night in the village before commencing operations. She does not retire to rest like the other villagers, but wanders about the live-long night, listening to spirit voices. If she sees a poor wight outside his house after the usual hour for retiring, she brings that up against him next day as evidence of guilty intention, and that, either on his own account, or on account of his friend the wizard, he meant to steal away to dig up the horns. The dread of such dire consequences keeps the villagers within doors, leaving the sorceress the whole night to arrange for the tableau of the following day.

In addition to the horns, arms and pieces of human flesh may be dug up in suspicious places, and this is the carrion on which witches and wizards feed. Any one tasting a morsel of such food is himself thereby converted into a wizard. Witches and wizards have midnight feasts, so says the legend, at which they gorge themselves with human carrion. Hence it is that in many parts the dead are not buried till putrefaction sets in, and graves are watched a considerable period after interment. The detective may not be known as such to a wizard, and may pretend to follow the same art in order to gain his confidence. If, then, the wizard offers the detective human carrion, no further proof of guilt is needed. Whether such food is ever offered to these rogues it is difficult to say, as their word is accepted without question or inquiry.

Witches can cause milk to flow down through a straw from the roof of a house,* and by this means rob their neighbors of the milk of their goats and cows. When I read of this superstition for the first time it reminded me of an incident, connected with a similar Celtic superstition, which happened in Sutherlandshire about twelve years ago. In that region a superstition still lingers that witches can "steal the feet" of cows by walking through the fields while the dew is on the grass, dragging a rope made of cow-hair after them. A Thurso mason, well acquainted with north country superstitions, was employed in the district at the time referred to, and got a quantity of new milk daily from a crofter's wife. At the beginning of August she sent to say she could no longer let him have new milk, as that went to the shooting lodge, but he could have milk from which the cream had been taken. The wily rogue sent her the following message: "Tell your mother I do not wish to be nasty, but I must have new milk, if not by fair means, then otherwise. I shall take it from the rafters of the house rather than want." Next morning the girl appeared with skimmed milk, thin and blue. Malcolm had meantime made his preparations. He had bored one of the roof couples, and fixed a bladder filled with milk in the thatch so as to empty its contents through the hole when required. He then carefully plugged the hole. When he saw the quality of the milk sent, he asked the girl into the house that she might see what happened there. He next took an auger and bored the plug away, when down came a stream of rich milk and cream. After that he had but to ask what he required. No one dared refuse his most extravagant demands. His reputation as a wizard spread far and near over the country side, and still lingers there among the superstitious.

Wizards visit their victims while asleep, and "instill" a power-

* This is pretty general in East Central and South Africa.

ful poison, known only to themselves, into the ear.* For this there is no cure; the patient withers away, and dies "when all the flesh has melted off the bones." They bewitch fowls, cattle, crops, everything a man possesses. They make his wives barren, and himself incapable of begetting children. They put enmity between him and his friends. In one word, there is no evil but they practice, and a great deal of the legislation of the country is designed to put down this crime, and punish those who are found guilty of it.

In South Africa war resolves itself into a cattle hunt; in the lake region of East Central Africa it is largely a slave hunt. A dangerous neighbor or rival can be effectually curbed by carrying away a large number of his subjects and sending them to market. This resolves war largely into raiding by means of a sudden and unexpected descent. The elaborate preparation of the South would warn the whole country, and while the doctor was engaged "charming" the army, and distributing magic tokens to render the braves invulnerable, the enemy would have put "seven hills" between himself and the advance column. All the same, there is a close resemblance between the war usages of the South and what we find in Central Africa. There we find, especially among the Angoni, the Basuto habit of cutting out an enemy's heart and liver, and eating them on the spot. We also find the habit of mutilation, for the purpose of reducing the parts to ashes, to be stirred into a broth or gruel, which must be "lapped" up with the hand and thrown into the mouth, but not eaten as ordinary food is taken, to give the soldiers courage, perseverance, fortitude, strategy, patience, and wisdom. Should a brave leader retire to a mountain, and die there unconquered, his spirit becomes, according to Yao tradition, the guardian of the rain clouds that gather there, and to him offerings and prayers are presented at the great national gatherings for rain. Mantanga inhabits Mangohi, the mountain the Yao remember as their home, and to him they pray and sacrifice for rain. He is liberal to his children, and bestows great plenty. Chitowe, on the other hand, is surly, and is associated with drought, famine, and leanness. He sometimes appears as an emaciated child or a young woman. These, and many others, are the spirits of warriors who perished centuries before the white man came to bring a new and terrible implement of destruction, and to introduce strange customs and stranger gods to people whose ways have been uniform since before the Flood.

Death is largely caused by wizards. The very introduction of death into the world has a suspicious look of witchcraft about it; in any case, it was caused by a woman who taught two men to go

* Manganga, Angoni, Yao, Walolo.

to sleep. One day while they slumbered, she, more cruel than Jael, held the nostrils of one till his breath ceased and he died.* So it happens that "death and sleep are one word." When a man dies, if his death was caused by witchcraft, there is no safety for any one till the suspected person drinks the poison bowl. How such are discovered has been already indicated; the poor wretch who must drink the poison may be the man's most intimate friend, his nearest relative, or perhaps his wife. There are even occasions when a large quantity of *mwai* is prepared and numbers take it together. In this case wizards and witches are "cleaned out" wholesale. The practice is not uncommon on the Shire and the Zambesi.

Apart from the discovery of the culprit, the dead are mourned for by a persistent beating of drums by night and by day,† and also by a continued howling kept up by relatives and others, of whom many may be hired for the occasion. The louder the drumming, the greater the grief. Relatives shave their heads, and in the case of a chief this is done by all his tribesmen. At the grave offerings are made, and the same is continued for a varying period at the votive pot placed on the site of the deceased's house.

At times, in the case of persons of social importance, as generals in the army and councilors, mourning is prolonged for many days before sepulture takes place, and in that case the body is incased in bark and placed in a suitable position, with a hole dug in the floor underneath to receive the decomposed and putrefied matter which exudes from it. The body is ultimately buried in the house, which is razed, and the materials carried away, that the spot may be leveled and a votive pot placed there. A slave is frequently killed and put in the same grave with his deceased master, that the latter may not have "to go alone." Enemies killed in war are not buried.

When sepulture is to occur in the usual place, and according to the general custom of the country, the body is wrapped in a mat, usually the person's bed, and a curious custom observed by Yao and Wayisa, who perform this office, is washing their hands as a ceremonial act. This is quite distinct from the idea of uncleanness after handling a dead body, which requires bathing in running water before eating or associating with their fellowmen. After the ceremonial act of washing is performed, the body is carried to the grave suspended along its length to a bamboo pole. When the grave is dug, it is carefully lined with palisades and green branches. At either end a forked stick is driven se-

* Yao tradition, told also by Wayisa.

† Macdonald, Description of Funeral and Mourning Customs in Nyassa Regions. Mock funerals are most common among the Angoni.

curely into the ground at the bottom of the grave, and the body suspended to the bamboo pole is placed in position, the ends of the bamboo resting on the forked sticks, and preventing its touching the ground. A canopy of boughs is then placed over it to prevent the earth falling down on the body, and the grave is filled in as is usual. A slave may be killed to accompany the deceased, but not necessarily. The house occupied by him is burned, and a votive pot placed on its site. Similar pots are also placed on the grave. When the chief of a tribe dies, he is buried in his house, which is not taken down nor burned, and in this case the votive pot is placed outside the door, under the veranda. The personal articles of the deceased—pipes, broken spear, walking-sticks, ornaments, badges of office, charms, and wallet—are placed in the grave, and this seems to be common among all, or almost all, African tribes. When mourning for the dead is concluded, which is after a varying period, there are feasting, drinking, revelry, and a second shaving, after which the dead is forgotten, or at all events seldom or never mentioned except as an ancestor to be worshiped, and then not by name, but by relation—"my father," "my brother," "my chief," "my chief's son," etc.

A man worships the spirits of his own ancestors; a village, those of its departed heads; a tribe, those of its chiefs. The names of great warriors are kept long in remembrance, and we meet with many such whose history, exploits, and country are quite lost, but whose memory tradition preserves as great spirits who are high in rank above ordinary ancestral gods, and on whose will depends the destiny of peoples and the conditions of life as regards plenty or scarcity. This is common to almost all Bantu tribes. Worship takes the form of prayer, offering, and sacrifice. Reference has been made to the manner of human sacrifice, and its frequency among certain tribes is appalling. When the gods are offended, men must die; when hungry, cattle or fowls serve their turn; and when only to be propitiated, as in view of a favor desired, flour or corn is acceptable to them. At great national gatherings—as for rain—the magician, in the priestly character, conducts the sacrifice and the prayers, as also in cases of disaster and national mourning. In connection with rain-making, the chief supplicates his own special god or guardian ancestor. A dance is held in his honor, and the chief throws up water to indicate that he prostrates himself and his people at the spirit's feet, who has the giving or withholding of that for which they pant and die. At times *Mpambe* (lightning), in the form of a deity of the clouds, is invoked for rain by Yao and Shirwa tribes, but *Mulunga,* the great spirit—or more properly great ancestor—is the deity to whom men look for help in times of distress and drought. This worship of Mulunga leads to a kind of tribal pantheism in

the lake region, for, after all, is not the Earth the mother of us all, Mulunga himself included? In the more private devotions of the people of the Nyassa region Mulunga does not appear, but a man may not only pray and sacrifice to his own ancestors, but also to the old inhabitants who occupied the country before his forefathers took possession of it. The people are gone, all dead, but their spirits live, and dwell in the old place, and see all that goes on in which they take an interest. There do not seem to be family and tribal distinctions as such among spirits; in any case, they do not fight about territory as men do. No Milton has yet appeared in Central Africa to set the spirits by the ears.

The dead, however, may reappear in the form of animals, but only for pure mischief.* Widows are often held in bondage and terror by their lords returning in the guise of a serpent. This brute will enter the house, hide in the thatch, and look at its victim from between the rafters. It will coil itself by the fire and steal into the beds; it will glide over articles of food and explore the interior of cooking utensils. For this persistent persecution there is but one remedy, and that is to kill the serpent, when there is nothing left but "pure spirit," which can not appear in material form any more.

A Yao spirit appearing in material form is different from a spirit's messenger, which also appears in animal guise. The latter may be a bird, a form which a spirit can not assume, but which can be sent as a messenger, to make known the spirit's will, somewhat after the manner of those sacred chickens which the stout old Roman threw over the side when they refused to eat. The African, too, can deal somewhat summarily with bird messages when his interests and inclination lie in that way, but this implies a degree of courage which is phenomenal.

Among the Angoni and the people dwelling on the western side of Lake Nyassa there is a common belief that demons hover about the dying and dead before burial, to snatch away their souls to join their own evil order. By the beating of drums and firing of guns such evil spirits are driven away, but a more certain method of avoiding their machinations is to have a mock funeral, and so mislead and confound them. When it is determined to have such a funeral, an artificial body is manufactured of any convenient substance, and treated exactly as is done with the bodies of the dead. This lay figure is carried a considerable distance to a grave, followed by a great crowd, weeping and wailing as if their hearts would break. Drums are beaten, guns fired, and every species of noise made. Meantime the real corpse is interred near the dwelling as quietly and stealthily as possible. The evil

* Angoni, Manganga, Waomba, Anyasa, etc.

spirits are effectually deceived; when the mourners retire, there is nothing in the mock grave but a bundle of rushes, while the true grave they do not know and can not find. Traces of this still linger in the South.

As the African must account for the origin of death, so, too, he has a theory regarding the first appearance of man on the earth. Both he and all other animals came out of a hole in the ground, after which Mulunga—the great ancestor—closed up the opening. The place is now desert, no man dwells there, and the spot is known to none. The gods refuse to reveal it. Whether this is that it may not be opened, and other creatures be allowed to escape from it, their philosophy does not very clearly explain, but what is very certain is, that monkeys were men at the time of their exit from the earth,* but having quarreled with their friends, went to "dwell in the bush." To vex and harass those whom they left, they began to pick the seed from the ground after it was sown, and this habit having grown to be hereditary, monkeys can not grow corn, as they "could not leave their own seed in the ground," which is perhaps as good a definition of the difference between men and monkeys as any given by scientists.

Reference to monkeys reminds one of that wonderful procession seen by the pasha, where each carried a torch to light him in his depredations among the corn-fields—a story which one man explains by referring it to Emin's defective eyesight, another to a possibility of monkeys being able to produce fire by friction. Without giving any opinion regarding the accuracy of the observer, a statement made to me by a South African native, a Pondonusi, may throw as much light upon it as all our science. At the time I paid little attention to it, and indeed it passed quite from my mind till I came across the pasha's story in Mr. Stanley's book. It was, so far as I can recollect, in the following words—the connection in which it was told is of no importance: "The master is surprised. There are monkeys in the mountains" (the gorges of the Drakensberg) "that go to the fires men leave in the bush, and carry away burning sticks; they even go up the trees with them, and then throw them down. I have not seen it myself, but I have heard say that when women leave a fire near the edge of the bush, they come out to the grass openly with burning pieces of wood, and play with them—some say they carry them back to the fire to make them burn better." If this is a true and sober version of what is not uncommon, a little less science and a little more ordinary intercourse might have saved the eminent if erratic German a good deal of idle speculation. One can quite fancy monkeys playing with fire-brands found near the edge of

* This tradition Mr. Macdonald found common in the Shirwa and Nyassa regions.

the forest, carrying them off in their march to the corn-fields, to cast them aside when the work of depredation began.

If man's origin can be satisfactorily accounted for, his destiny is shrouded in impenetrable gloom. All spirits live, nor can they be killed; but how employed or what country they inhabit is known to no one. It is true a man's ancestors watch over his life, and the chief's ancestors guard the honor of the tribe, but beyond this all is uncertainty and doubt.* A man's spirit is not at his grave, though it may be met there; it is not at his old home, but still it sees the offerings placed in the votive pot. It does not inhabit his son's house, though he can not cut his nails or trim his hair without his father's eye being upon him; and should he fail to bury the clippings of his nails or to burn the produce of the barber's shears, he may expect to be reminded of it in the most unpleasant manner. Nor is it a man's own actions alone that come under the cognizance and censorship of his father's ghost. Should his wife, while he is on a journey, anoint herself with the oil or fat in daily use, she will not only suffer herself, but bring calamity upon her husband; should she dream during his absence, she must offer a private gift for herself and the absent one. So far the wishes of spirits are known, but how they employ themselves in the spirit land, and what are the mutual relations between them, has never been told. A chief remains such in virtue of his office, but as to the relations between rival chiefs and old enemies, "the people who are here do not know; it never was known, for they never told."

Turning from speculations regarding creation, life, and death to the daily concerns of this world, we meet with a number of very curious minor customs and institutions among the Yao and allied tribes. One of these is that of surety, or what we might call God-parent. Every girl has a surety, and when her hand is sought in marriage it is this official who is approached, and not her parents. He makes the necessary arrangements, and sees what provision is to be made for her and her children, should she have any; and also, in the event of her being sent away without just cause, how she is to be supported and cared for. When a free wife—for this institution applies only to free women—is dismissed, she returns to her surety, and he redresses her wrongs, and makes such adjustments as the circumstances admit of.

In the ordinary conduct of affairs, domestic and public, women have no voice; everything is regulated by the men, who may be said to sit perpetually in council. A Yao woman, asked if the

* The following customs are gleaned from notes and references by missionaries in the Nyassa and Tanganyika Lake regions, no particular tribes being named. The customs seem common.

child she is carrying is a boy or girl, frequently replies, "My child is of the sex that does not speak." The position of woman is practically that of a chattel. Women kneel when addressing men, and go off the public path into the grass or bush when they meet any of the opposite sex as a sign of subordination and subjection. Young girls do not take milk; if they did it would make them barren. Women, especially Makololo, wear a lip-ring the size of a small table napkin-ring in the lip, not suspended, as earrings are, but inserted into the lip as the "eyes" through which "reef points" pass are inserted between the canvas of the sail and its "bolt-rope." It causes the lip to project an inch and a half in front of its natural position, and at right angles to the teeth and gums. A small brass or lead ornament is suspended from the side of the nose, which is pierced for the purpose as the lobe of the ear is for earrings. Some of the front teeth are knocked out as a beauty mark, and the arms, cheeks, breast, and shoulders are tattooed with strange and fantastic devices. Necklets of teeth, shells, or bits of wood are common, and brass wire is in great demand for bracelets and anklets. The dress consists of a loin-cloth of skin, cotton, or bark. The latter is made by stripping a piece of bark from a tree, and then beating it with an ebony hammer till soft and pliant. It is easily torn, and even when treated with the greatest care does not last long. On the Shire and round Lake Nyassa the people have hardly any stock except fowls and a few goats, and are thus precluded from having the comfortable sheepskin garments so common among the Kaffirs. Domestic animals are precious in Central Africa, so when chickens are hatched the abandoned egg-shells are collected and hung up in the house to protect the brood from hawks and accidents of all kinds.

The principal industries among the tribes whose customs I am considering consist of pottery and working in iron.* They manufacture clay pots of beautiful design, and burn them with considerable skill. There is a tradition lingering in odd corners that once upon a time their ancestors used hollow stones as pots before the art of pottery was discovered. If this is true—of which there is no adequate proof, however—it effectually disposes of Don Santos's idea that the East Central African had gradually degenerated from a higher civilization, and points rather to a record of progress. And there seems to be beyond question steady, if slow, progress in their skill in working metal and fashioning implements of war and husbandry. There is no question that within a comparatively recent period they tilled the ground with wooden

* The Angoni own a tribe of inner Africa which they have reduced to the position of domestic slaves. They are the best smiths in the lake region. Whence they came I do not know, but they were not natives of that region originally.

implements, for the memory of it lives in universal tradition among them. At no very remote date a Tubal-Cain appeared, and since his day the iron-headed hoe has found its way into the remotest hamlet, and the national ingenuity has found exercise in fashioning and ornamenting weapons of war. The improvements made in the manufacture of implements of husbandry and tools for the craftsman are insignificant compared with the advance in the manufacture of spear and battle-axe. The iron they smelt from its native ore by a primitive process of blast furnace, and then work and temper it much as was done by our country smiths two or three hundred years ago. I have seen spears of African manufacture, made by Baralong smiths, tempered so finely that it required a good Sheffield blade to turn their edge. This is, however, exceptional, and the vast majority of articles made are soft, and the iron coarse in texture when broken. In woodwork their progress has been slower, and beyond polishing spear-handles and the manufacture of musical instruments, pillows—a regular article of commerce—pipes, walking-sticks, and mallets, not much is done, the manufacture of canoes, their greatest triumph, being always excepted.—*Journal of the Anthropological Institute.*

[*Concluded.*]

## THE BAY OF FUNDY TIDES AND MARSHES.

By FRANK H. EATON.

CONCERNING the Bay of Fundy the school-books generally note the single fact that "here the tides rise higher than anywhere else in the world." But so meager a reference to what is in itself an imposing exhibition of gravitational energy, helpful as it may be in a mnemonic way to the learner of geographical catalogues, gives no hint either of the extraordinary series of physiographical conditions which are the cause of this phenomenon or of those which it creates. The Bay of Fundy is remarkable not only for the grandeur of its tidal phenomena, but equally so for the exquisitely picturesque sculpturing of its coast line, and the diversity, range, and richness of geological evidence thereby revealed; for the unique character of the extensive alluvial tracts that skirt its head waters, and for the wealth of legend, tradition, and romantic incident embodied in the early history of the people that dwell about it.

What is the cause of the extraordinary height of the Bay of Fundy tides? What part have they played in the creation of the Acadian marshes? Whence have been derived the materials for this enormous alluvial deposit? And what is the source of its ex-

haustless fertility? These are questions often asked by tourists, and which are answered, imperfectly no doubt, in the following pages.

North of Cape Cod the continental coast line recedes abruptly westward, and then sweeps in a long curve northeastwardly till the head waters of the Bay of Fundy are reached. Turning again on itself, its course is westward to Cape Sable, from which it again stretches away toward the east as the southern shore of Nova Scotia. Thus, between Capes Cod and Sable lies the long, narrow, open Bay of Maine, which terminates toward the north and east in the landlocked Bay of Fundy. In the shallow waters of this larger open bay the tidal impulse, which over ocean depths moves only as a wave of vertical oscillation, is changed into one of translation. As the effect of this transformation the whole body of water moves first landward, and then, sweeping round with the curving coast line, skirts the southern shores of Maine and New Brunswick, till it reaches the narrow strait between Briar Island and Grand Manan. Compressed between these closer limits the water is forced onward with increasing velocity into the Bay of Fundy. Part finds its way into the Annapolis Basin and its tributary rivers, while the main current moves onward till it meets the tongue of land which terminates in Cape d'Or. Here it divides, the northern portion filling Shepody and Cumberland Basins; while the southern half rushes onward through the narrow entrance to the Basin of Minas. As it passes Cape Blomidon this swirling, eddying, foaming torrent reaches its greatest velocity—a rate of ten or twelve miles an hour.

Thus it is that the long, sickle-curved Maine coast gradually gathers up the water rolled upon it twice a day by the rhythmic ocean movements, and, throwing it backward, presses it at last into the funnel-shaped Bay of Fundy and its adjacent basins, covering with a semidaily flood the low and unprotected marsh-lined shores and filling the channels of the tributary rivers for many miles inland to a height of ten, twenty, or thirty feet above their fresh-water levels. Such, in a general way, is the set of conditions under which the spectacular and physiographical effects of ordinary tidal phenomena are exaggerated in the Fundy tides far beyond their normal limits. At some points the extreme elevation of the flood tide above low-water mark is as great as seventy feet. In some of the rivers, particularly in the Peticodiac of New Brunswick and in the Shubenacadie of Nova Scotia, the upward flow against the fresh-water current forms a rapidly moving wall or bore several feet in height, the rushing sound of which can be heard at a considerable distance, while in others the two currents meet and mingle so quietly that an observer can hardly tell where the backward flow begins.

Lining the shores of the head waters of the bay and spreading far inland up the valleys of its river tributaries are extensive tracts of alluvial marsh land of remarkable fertility, and differing in their origin from other so-called marshes. In general, alluvial deposits are formed in river basins, by materials washed down from higher levels by fresh-water floods; but here the whole deposit is of tidal origin, the result of a landward rather than a seaward transportation. Every incoming tide is freighted with a finely comminuted sediment, the product of the wearing action of the currents upon the sides and bottom of the bay. During the interval between the flood that covers the undiked river and basin margins and the ebb that leaves them bare again, the sediment is deposited as a film of soft and glistening mud upon the somewhat hardened material left by previous tides. Thus layer after layer accumulates, until the flat becomes too high for any but extraordinary tides to cover.

Instructive illustration these marsh flats often give of Nature's methods in the preservation of the records by which the geologist reads the physical history of the earth. So plastic and impressionable is the mud which an outgoing tide has left that it easily takes and holds the tracings of any disturbing contact. A wind-blown leaf, a resting insect, a drop of rain, may make in it a tiny mold which, hardened somewhat before the next incoming flood, receives thereafter successive linings to which it gives its form and markings. In this way even the rain-prints of a passing shower have been fixed, and then completely covered up; and yet when subsequently exposed, so perfectly were the spatter marks preserved, that one could tell in which direction the wind was blowing when the shower fell.

It is obvious that the deposition of tidal sediment can, in general, be made only between the lower and the higher limit levels of the ebb and flow. The accumulation of greater depths of mud than such a range permits can only be accounted for by the supposition of a gradual subsidence of the littoral areas—a movement which would also widen the area of tidal inundations. That such a steady and prolonged subsidence of the Fundy marsh-lined shores has been in progress since the marsh began to form is attested to not only by the surprising depths of mud accumulated, but also by the occurrence in many places, especially along the shores of the Cumberland Basin, of deeply buried forests which were clearly once above the coexistent tidal levels.

A general idea of the geological features of the great depression in which the Bay of Fundy lies is necessary to a fuller understanding of the nature of these Acadian marshes, and especially of the sources of their wonderful fertility. In early geological times, and until long after the close of the Carbonifer-

ous period, the bay was much wider and somewhat longer than it is now. The long ridge of trap rock, known as the North Mountain, which stretches as a huge wall between the Annapolis Valley along its southern, and the waters of the bay along its northern base, did not then exist, and the waters of the bay extended uninterruptedly over the whole of the Annapolis Valley to the base of the Silurian hills which, under the name of the South Mountain, now form the southern inclosure of the valley. Eastwardly the head waters of the ancient bay washed the Devonian and Carboniferous rocks of the Cobequid Hills, while the northern shore line of the present bay, skirting the southern limit of the Palæozoic rocks of New Brunswick, is substantially identical with that of the original bay.

In general character the tidal movements of this larger Atlantic inlet were the same as in the smaller modern bay. And the semidaily ebb and flow of the waters produced, by their incessant attrition with the carboniferous limestones, shales, and sandstones, and the other ancient rocks that formed the bed and margins of the bay, immense quantities of sand and mud—sediment that was redistributed over the greater part of the Fundy Valley. Subsequent changes of level caused a recession of the waters to within their present limits, and brought to view, as the Triassic, or new red sandstone, extensive areas of these deposits. These red sandstone strata are still to be seen in shreds and patches at various points in the Annapolis Valley and on the shores of the Minas and Annapolis Basins. Their general dip toward the north indicates that the epoch-closing movement which narrowed the Bay of Fundy within its present confines was a sinking of the bed along its northern or New Brunswick border.

Following this subsidence, and as the concluding events in the series of seismic convulsions by which the region gained its present topographical features, occurred the volcanic eruptions in which the North Mountain had its origin. This long, trappean wall forms the southern boundary of the bay from Cape Split to the extremity of Digby Neck, a distance of one hundred and twenty-five miles, the only interruption to its continuity being the singular gap called Digby Gut, which gives an entrance into the beautiful Annapolis Basin. Though there were probably many volcanic vents along this extended line of fracture, yet the scene of greatest activity was undoubtedly near Cape Split, at the entrance to Minas Basin, scattered along the shores of which on either side are isolated patches of amygdaloidal trap. Transverse ridges of the same volcanic rock run at intervals, also, across the bottom of the bay.

It is the grinding action of the Fundy waters upon these two Triassic rocks, the trap and its underlying sandstone, that provides

the tidal currents with an unfailing supply of muddy sediment. It is mainly in the erosion, transportation, and reprecipitation of these two rocks, and especially of the latter, that the process of marsh formation consists. The incessantly destructive tide-work may be seen at many points along the shore line, perhaps most conspicuously at the base of Blomidon. Here the sandstone foundation is continuously being cut away from under the superincumbent columnar trap; and at intervals, especially in the spring time, large masses of the igneous rock are loosened from the precipitous mountain side and crushed upon the beach below, where the solvent and abrading action of the waters can reach them. It is after one of these spring slides that the richest harvests of amethystine and zeolitic crystals, for the beauty and abundance of which the Minas shores are noted, can be secured. But it is along the bottom of the bay that the destructive tidal work is most extensive and effective. Here exist great troughs, furrowed out of the soft sandstone, many fathoms deep along the channel bed, with here and there the interruption of the transverse trappean dikes already spoken of.

The sandstone yields, of course, the greater part of the marsh-creating sediment. Its detritus consists of a large percentage of silica, a little clay, the iron which mainly determines its reddish color, and the calcareous matter which served as cement in the parent rock. This material, in the extremely comminuted form in which it occurs in marsh-land soil, would itself afford conditions highly favorable to the support of vegetable life. But an additional cause of the wonderful fertility of the Acadian marshes is the richness of the trap rock in various salts of potash, lime, and alumina which the action of the water mingles freely with the sandstone mud. The plant-supporting power of this complex soil is increased still further by contributions from the upland soils through the medium of the streams and rivers flowing toward the bay.

The great fertility of this alluvium may be inferred from the fact that portions of the Annapolis, Cornwallis, Grand Pré, and Cumberland marshes have been producing annually for nearly two centuries from two to four tons per acre of the finest hay. Besides, it is a common practice, after the hay has been removed, to convert the marshes into autumn pastures, on the luxuriant tender after-growth of which cattle fatten more rapidly than on any other kind of food. Thus, virtually, two crops are annually taken from the land, to which no fertilizing return is ever made. The only portions of the Acadian marshes that have as yet shown signs of exhaustion are those about the Chiegnecto branch of the bay, on the cliffs and bed of which the Triassic rocks do not occur, but in their stead a series of blue and gray "grind-

stone grits" of an earlier formation. In this region the marshes situated well up toward the head of the tide, where the red soil of the uplands has been mingled with the gray tidal mud, are good, while those lower down are of inferior quality and less enduring. Efforts are being made to renew and improve these inferior tracts by admitting the tide upon them.

In general, however, the necessity for periodic inundations by the muddy waters of the bay in order to maintain the productiveness of the marshes, as implied in the passage from Evangeline—

> "Dikes that the hand of the farmer had raised with labor incessant,
> Shut out the turbulent tides; but at stated seasons the flood-gates
> Opened and welcomed the sea to wander at will o'er the meadows"—

not only does not exist, but, on the contrary, some two or three years are required for the grass roots to recover from the injury done them by the salt water, when, as occasionally happens, an accident to the protecting dikes admits the *un*welcome flood.

The exceedingly fine texture of the soil, and its consequent compactness and retentiveness of moisture, render it for the most part quite unsuitable for the production of root crops, and at the same time adapt it admirably for the growth of hay and of cereals, especially oats, barley, and wheat. As a rule, however, the succession of grass crops is interrupted only at intervals of from five to ten or more years by a single crop of grain. The reproductive power of the grass roots declines perceptibly with long-continued cropping, so that a renewal of the stock by reseeding is occasionally necessary. For this purpose the marsh is plowed in the autumn or spring and new seed sown; but to avoid the loss of a season, since grass does not mature for harvesting the first year, grain is also sown and a large yield usually obtained. This plowing and reseeding at intervals often of many years is the only cultivation the soil receives or requires. There is no reason to suppose that abundant harvests of grain might not be obtained annually for an indefinite period, but, as this would involve annual tilling, the hay crop is more profitable.

Along the river estuaries the encroachment of the land upon the sea is in continual progress, so that there are always considerable areas of unreclaimed salt marsh, the lower portions of which are flooded every day, while the higher portions are covered only by the highest tides. The reclamation of such new marsh is effected by building around its seaward margin a wall or dike of mud to prevent all tidal overflow. After two or three years the salt will have sufficiently disappeared to permit the growth of a crop of wheat, and in a year or two more the best quality of English grass will grow.

At the head of Cumberland Basin an interesting experiment in

the reclamation of worthless land has been successfully tried. Large areas of swamp and in some instances shallow lakes have been connected with the tidal waters of the neighboring rivers by channels cut through intervening ridges of upland, thus effecting the double purpose of draining and of admitting the mud-laden tides. In this way, in five or ten years, many acres of worthless swamp have been converted into valuable dike-land.

The use of marsh mud as a fertilizer is very general among farmers to whom it is accessible. It is taken in the autumn or winter from the bank of some tidal creek or river, where the daily depositions can soon replace it, and spread directly on the upland. Its effects are twofold: it enriches with valuable supplies of plant food the soil to which it is applied, and it greatly improves the texture of all light and open soils, making them more compact and firm, and so more retentive of moisture and of those ingredients which are otherwise easily washed away. This permanent effect upon the physical character of the soil which the marsh mud produces renders undesirable its application to clayey soils already compact and firm and moist enough; for it makes them more difficult to work, and more impervious to atmospheric influences. To well-drained hay fields, however, which need but little cultivation, the mud may be advantageously applied, even though the soil be naturally stiff and heavy.

The French settlers were the first Acadian dike-builders. They brought the art from the Netherlands; and to this day no other class of provincial workmen is as skillful in the often difficult work of dike construction as the Acadian French. It was no doubt the existence of these vast areas of marsh land, whose potential value was even then clearly seen, that induced the first New World immigrants to settle about the Bay of Fundy shores; and it was these same broad, fertile marshes left unoccupied by the expulsion of the Acadian French that attracted the New England settlers, whose descendants now derive from them an income aggregating not less than a million dollars annually.

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As described by B. F. S. Baden-Powell, in his In Savage Isles and Settled Lands, the aboriginals of Australia are an extraordinary people—to look at, "quite unlike any other human beings I ever saw. A thick, tangled mass of black hair covers their heads; their features are of the coarsest; very large, broad, and flattened noses; small, sharp, bead-like eyes and heavy eyebrows. They generally have a coarse, tangled bit of beard; skin very dark, and limbs extraordinarily attenuated like mere bones. But they always carry themselves very erect. . . . They wander about stark naked over the less settled districts, and live entirely on what they can pick up. . . . If not the lowest type of humanity, they would be hard to beat. They show but few signs of human instinct, and in their ways seem to be more like beasts."

# SKETCH OF SIR ARCHIBALD GEIKIE.

THE most prominent features in Sir Archibald Geikie's geological work are his studies of the effects of volcanic force, beginning in Scotland and extending to many countries; and his explanations of the fundamental part which geological processes have played in shaping the topographical features of the land, and in the origin of natural scenery.

Prof. Geikie was born in Edinburgh in 1835; was educated at the high school and the university in that city; was appointed an assistant on the Geological Survey of Scotland in 1855; acquitted himself so well in that capacity that when the Scottish branch of the survey was made a separate establishment in 1867, Sir Roderick Murchison appointed him its director. In December, 1870, he was appointed to the new professorship in the University of Edinburgh of Geology and Mineralogy, founded by Sir Roderick Murchison, with a concurrent endowment by the crown. He held this position till the beginning of 1881, when he resigned it, to take the place of Sir Andrew C. Ramsay as Director-General of the Geological Survey of the United Kingdom, and Director of the Museum of Practical Geology in London.

The published record of Prof. Geikie's life relates exclusively to his investigations, papers, addresses, and books on subjects relating to geology. In this field he has labored with unceasing diligence, and to it he seems to have devoted the whole energy of his active career. Complicated problems presented themselves to him when he entered upon the surveys, of which he was called upon to work out the solutions. One of the first to attract his attention was the relation of the crystalline rocks of the Highlands to the Silurian strata on which they rest, which Murchison had accepted as normal; an assumption from which logically followed the hypothesis that these gneisses were altered sediments. Mr. Geikie gradually became dissatisfied with this view, and commissioned two assistants to review the fields in which the most decisive evidence was to be obtained, instructing them "to divest themselves of any prepossession in favor of published views, and to map existing facts in entire disregard of theory." From the evidence afforded by this survey, Murchison's view was proved to be a mistaken one; and for it was substituted the theory that the elevation of the mountains and the metamorphism of the gneisses were the effect of enormous pressure resulting in the folding and breaking of the whole border of the dry land. The mountains have been reduced to their present shape by denudation, by which also much of the evidence of plication has been washed away, while the remains of the disturbed rocks occupy the position

which suggested Murchison's view. The displacements were accompanied by modifications of the rocks, of which Geikie wrote that "in exchange for this (Murchison's) abandoned belief we are presented with startling new evidence of original metamorphism on a colossal scale, and are admitted some way into the secret of the processes whereby it has been produced."

Sir Archibald Geikie's chief geological work, according to the estimate of Nature, seems to be his exhaustive review of the volcanic history of the British Isles. The northwestern part of Great Britain is marked, like the Snake River region in our own country, by the evidences of the outpouring over the land of immense sheets of lava, which in the present instance took place in Tertiary times. Sir Archibald made it his task in the investigation of this phenomenon "to discern the site of the centers of eruption, and determine the old chimneys, the remnants of which give a glimpse into the lowest parts of ascending lavas; to discriminate the volcanic necks, the intrusive sheets and dikes, the bedded lavas and the tuffs." Evidences of still earlier volcanic activity were also found in the Old Red Sandstone of Scotland, and in the oldest formations of England and Wales. In order to prepare himself more thoroughly for the investigation of this phenomenon, Mr. Geikie traveled over much of Europe, from northern Norway to the Lipari Islands; then came over to Canada and the United States, and followed the course of our geological surveys, particularly in the Western States and Territories and the lava-covered regions. In another department of the same investigation he gave more attention to petrological studies than any Englishman had done before him. Besides giving rise to many valuable memoirs relating directly to what he had seen and observed, these studies contributed greatly to the enlargement of Prof. Geikie's views and to the increase of the breadth of his work; and some of their results may be seen in the greater richness of illustration apparent in his subsequent writings. Their mature fruit is presented as a whole in his presidential addresses of 1891 and 1892. He was especially interested, they being exactly in the line of his principal study, in the lava beds of Snake River; and in his essay on the Lava Fields of Northwestern Europe refers to them as the site which first enabled him to realize the conditions of volcanic action described by Richtofen—the emission of vast floods of lava without formation of cones and craters—and, without acquiescing in all that author's theoretical conclusions, to judge of the reality of the distinction "which he rightly drew" between massive eruptions and ordinary volcanoes with cones and craters.

We have referred to Prof. Geikie's work in tracing the origin of the present shaping of land surfaces and of natural scenery to its geological factors as constituting one of his special titles to

fame. To his aptitude in this application Nature largely ascribes the success of his more popular works, which, it says, "will be easily understood if we remember that in Sir Archibald's works the traditional barrenness of geology is always smoothed and adorned by a deep and intense feeling for Nature. Nobody has done more than he to associate geological science with the appreciation of scenery." Mr. G. K. Gilbert, in a review of his Text-Book of Geology, remarks as a single departure in the volume the elevation of physiographical geology to the rank of a major division. "The same title, it is true, has been placed by Dana at the head of a primary division of the subject, but it was used by him in a different sense. With Dana it is a synonym for physical geology; with Geikie it is 'that branch of geological inquiry which deals with the evolution of the existing contours of the dry land.' So far as the subject has had place in earlier treatises, it has been regarded as a subdivision of dynamical geology, and the classification which placed it there was certainly logical. In dynamical geology, as formulated by Geikie, the changes which have their origin beneath the surface of the earth (volcanic action, upheaval, and metamorphism) and the changes which belong exclusively to the surface (denudation and deposition) are separately treated. In physiographical geology the conjoint action of these factors of change is considered with reference to its topographical results. Starting from geological agencies as data, we may proceed in one direction to the development of geological history, or in another direction to the explanation of terrestrial scenery and topography, and if the development of the earth's history is the peculiar theme of geology, it follows that the explanation of topography, or physiographical geology, is of the nature of an incidental result—a sort of corollary to dynamical geology. The systematic rank assigned to it by Geikie is an explicit recognition of what has long been implicitly admitted—that geology is concerned quite as really with the explanation of the existing features of the earth as with its past history."

The subject was first formally presented from this point of view in the Lectures on the Scenery of Scotland viewed in Connection with its Physical Geology, which were delivered in 1865. At this time, as Mr. A. H. Green remarks in his review of a new edition of the lectures in 1887, the controversy respecting Hutton's theory of denudation as the main and most efficient agency in shaping the earth's surface was at its height. The author acknowledged in the preface to his second edition that his views when first published ran directly counter to the prevailing impressions on the subject; but now, after a lapse of twenty-two years, they were accepted as part of the general stock of geological knowledge. "How largely," Mr. Green says, "this result is

due to his own steady and powerful advocacy all geologists are aware; but he gracefully reminds us that we also owe much to the labors of those American geologists who have found in the Western Territories such convincing instances of the work of denudation in shaping the surface." The first part of the book, comprising the lectures, deals with land-sculpture in general, and describes the working of Nature's sculpturing tools. The reader is then taken in succession to the different characteristic regions in the country and shown in detail, with much wealth of illustration, how the hills and valleys and salient features have been wrought out. The subject could very well be treated in such a manner as to make the presentation of it formal and dry in the extreme; but, says Mr. Green, the author "knows and loves his fatherland too well to look upon it merely as the object of geological research. Legend and history, old ballads and modern poetry, have all been pressed into his service, and he interweaves into his narrative allusion and quotation in a way that enlivens even the most technical parts of the volume. The chapter on The Influence of the Physical Features of Scotland upon the People shows well what a vast amount of human interest attaches even to so special a science as geology."

Prof. Geikie himself predicted in an address before the Geological Society of Edinburgh, in 1873, for the future of his theory: "Of one thing I feel surely confident: When the din of strife has ceased and men come to weigh opinions in the dispassionate light of history, the profound influence of the Huttonian doctrines of the present time on the future course of geology will be abundantly recognized. By their guidance it will be possible to reconstruct the physical geography of the continents in successive ages back into some of the earliest periods of geological history."

Prof. Geikie's theory is further elaborated and applied in his five lectures, delivered at the Royal Institution, in 1884, on The Origin of the Scenery of the British Isles. In these lectures the author held that "the present surface of Britain is the result of long, complicated processes in which underground movements, though sometimes potent, have only operated occasionally, while superficial erosion has been continuous so long as any land has remained above the sea. The order of appearance of the existing features is not necessarily that of the chronological sequence of the rocks. The oldest formations have all been buried under later accumulations, and their re-emergence at the surface has only been brought about after enormous denudation." The lectures conclude with an indication of the connection between the scenery of a country and the history and temperament of its people. This subject was considered from four points of view, the influence of landscape and geological structure being traced in the

distribution of races, national history, industrial and commercial progress, and national temperament and character. Prof. Geikie found in the United States an emphatic confirmation of his theory in one of the most impressive features of our geology, which he records, in 1887, in a review of Newberry and Macomb's Survey of the Upper Colorado. "The whole of this Colorado basin or plateau is justly regarded as the most magnificent example on the face of the globe of how much the land may have its features altered by the action of running water."

The method based upon this theory prevails in Prof. Geikie's Physical Geology, which is described by Dr. Jukes as "an example of the treatment of geographical questions from the point of view of the geologist." The author is actuated, the reviewer continues, "by the conviction of the necessity for a broader and more vivid presentation of the action and reaction upon one another of the various forces acting and reacting upon the surface of the globe than is usually found in works on physical geography, in order to convey a just idea of the character and significance of the features which it presents."

The subject is again presented in the presidential address at the Edinburgh meeting of the British Association in 1892, the special topic of which was the commemoration of the centenary of Hutton's theory and uniformitarianism, and in which special stress is laid on Hutton and Playfair's recognition of the fact that existing inequalities in topographical detail "are only varying and local accidents in the progress of the one great process of the degradation of the land."

This breadth of view concerning the methods and purposes of geological study marks those of the author's addresses of which that was the principal subject. In the opening lecture before the class in geology of the University of Edinburgh, delivered in 1871, he advises his hearers, "Let us turn from the lessons of the lecture-room to the lessons of the crags and ravines, appealing constantly to Nature for the explanation and verification of what is taught."

The introduction to his Class Book of Geology, published in 1886, concludes with the words: "Geology is essentially a science of observation. The facts with which it deals should, as far as possible, be verified by our own personal examination. We should lose no opportunity of seeing with our own eyes the actual progress of the changes which it investigates, and the proofs which it adduces of similar changes in the far past. To do this will lead us to the banks of rivers and lakes, and to the shores of the sea. We can hardly take any country walk, indeed, in which, with duly observant eye, we may not detect either some geological operation in actual progress, or the evidence of one which has now

been completed. Having learned what to look for and how to interpret it when seen, we are as it were gifted with a new sense. Every landscape comes to possess a fresh interest and charm, for we carry about with us everywhere an added power of enjoyment, whether the scenery has been long familiar or presents itself for the first time. I would therefore seek at the outset to impress upon those who propose to read the following pages that one of the main objects with which this book is written is to foster a habit of observation and to serve as a guide to what they are themselves to look for, rather than merely to relate what has been seen and determined by others." At the very outset in this work, geology is regarded, "not as an amusement for the collector and a means of learning where he will get pretty and curious objects for his cabinet; not as a field where the ingenuity or perversity of the classifying mind may delight itself with grouping natural products as reason prompts; not in any other of those limited aspects beyond which it is feared the wisdom of some geologists never reaches; but as a history—the history of the earth in ages long gone by."

Believing that no branch of the study should be overlooked, we find him lamenting, in 1871, that while in all that relates to stratigraphic geology the British had kept ahead of other nations, they had allowed petrography, or the study of rock species, to fall into disuse. Matters had improved, partly perhaps under his own influence, in 1880, when, writing of the Mineralogical Society of Great Britain, he remarked upon a revival of interest in mineralogy, which had before been neglected for fossil-hunting.

In one of the reviews of Prof. Geikie's Science Primer of Geology, in 1874, a curious omission is remarked, in that the author had not referred to Darwin's theory of coral islands as a "proof that a part of the crust of the earth has sunk down" —the reviewer suggesting that to lead pupils up to this theory, and then test it as Darwin had tested it, was "an excellent exercise in that peculiar kind of reasoning about past causation which is of the essence of geology." Prof. Geikie appears to have built, as the saying is, better than he knew; for in 1884 he confessed himself reluctantly compelled, in view of Mr. Murray's observations in the Challenger Expedition, to admit that Mr. Darwin's theory could no longer be accepted as a complete solution of the problem of coral reefs.

Prof. Geikie has long taken an intense interest in the American geological surveys, and has followed them up with the closest attention for many years; and his notices of their reports and summaries of their results constitute a very considerable part of his frequent contributions to Nature. He was fully impressed with the magnitude and extent of the geological phe-

nomena of the United States, and of the value of the study of them for the contributions it affords to our general knowledge of the subject and the explanations it furnishes of phenomena in other countries.

Writing on the subject in 1875, he said the United States had certainly done noble work in the exploration and mapping of its vast empire. Having spoken commendatorily of the style in which the reports were prepared and distributed, he added, "But whatever be their external guise, these narratives are pervaded by an earnestness and enthusiasm, a consciousness of the magnitude of the scale on which the phenomena have been produced, and yet a sustained style of quiet description, which can not but strike the reader." In reviewing Hayden's Report at the end of 1883, he ascribes a singular fascination to American geology. "Its features are as a whole so massive and colossal, their infinite detail so subordinated to breadth of effect, their presentation of the great elements of geological structure so grand, yet so simple and so clearly legible, that they may serve as types for elucidating the rest of the world. The progress of sound geology would assuredly have been more rapid had the science made its first start in the far West of America, rather than among the crumpled and broken rocks of western Europe. Truths that have been gained on this side of the Atlantic by the laborious gathering together of a broken chain of evidence would have proclaimed themselves from thousands of plateaux, cañons, and mountain ranges, in language too plain to be mistaken. No European geologist can visit these Western regions without realizing more or less distinctly what an amount of time has been wasted over questions about which there should never have been any discussion at all. This impression is renewed by every new geological memoir which brings to us fresh revelations of the scenery and structure of the Western Territories."

On the occasion of his appointment as Director-General of the Geological Survey of Great Britain and Ireland, Prof. Geikie was presented in March, 1882, by past and present students of the geology class in the University of Edinburgh with an illuminated address, recording their sense of loss on his leaving the university; referring to the distinguished services he had rendered the science; recognizing the signal success with which he had maintained the reputation of the Scottish school of geology, and of Edinburgh; and expressing the sympathy and affection with which they regarded him. Prof. Geikie responded in similar spirit, and said that he believed he was the first in Scotland, if not in Britain, to organize a practical class for the study of mineralogy and the microscopic investigation of rocks. He had tried always to make the cultivation of field geology a prominent part

of the work of the class; and some of their pleasantest associations had been among the glens of the Highlands and the hills and shores of the Lowlands.

Prof. Geikie is a prolific writer on all subjects relating to geology. When he was appointed in 1871 to the chair in Edinburgh he had the whole department to organize—a difficult task, but also an educating one—and to that, says Nature, we are indebted for the undisputed superiority which he has displayed in his Text-Book, as well as in his other educational writings, "such as the Class Book, a very model of clearness, whereby it has been once more demonstrated that those only are qualified for writing elementary books who are in the fullest possession of the whole matter." Likewise he is the author of small books or primers on Physical Geology and Physical Geography, of which some hundreds of thousands of copies have been sold, and which have been translated into most European languages, as well as several Asiatic tongues. He is also author of numerous memoirs in the Quarterly Journal of the Geological Society, the Transactions of the Royal Society of Edinburgh, the memoirs of the Geological Survey, the Quarterly and North British Reviews, Nature, etc.; of the Story of a Boulder, 1858; in conjunction with the late Dr. George Wilson, of The Life of Prof. Edward Forbes, 1861; of the Phenomena of the Glacial Drift of Scotland, 1863; The Scenery of Scotland viewed in Connection with its Physical Geology, 1865, and a new edition, largely rewritten, in 1887; in conjunction with the late J. B. Jukes, of a Student's Manual of Geology, 1871; of the Science Primers of Physical Geography, and Geology, 1873; Memoir of Sir Roderick I. Murchison, with notices of his Scientific Contemporaries, and of the Rise and Progress of Palæozoic Geology in Britain, 2 vols., 1874; of the Geological Map of Scotland, 1876; of the Class Book of Physical Geography, 1877; of Outlines of Field Geology, 1879; of Geological Sketches at Home and Abroad, 1882; of A Text-Book of Geology, 1882; of A Class Book of Geology, 1886. Prof. Geikie was associated with Sir Roderick Murchison, in the Scottish Highlands, in the preparation of a memoir of that district, and of a new Geological Map of Scotland, both published in 1861. He was elected to the Royal Society before reaching the age of thirty years, and is now its foreign secretary. He is past President of the Geological Society. He received the Murchison Medal of the Geological Society in 1881, and has been twice awarded the McDougal Brisbane medal of the Royal Society of Edinburgh. He is an associate of the Berlin Academy, of the Royal Society of Sciences at Göttingen, of the Imperial Leopold Caroline Academy, of the Imperial Society of Naturalists at Moscow, and a correspondent of the French Academy of Sciences.

# CORRESPONDENCE.

## THE FIRST TRANSATLANTIC STEAMER.

*Editor Popular Science Monthly:*

SIR: On page 424 of the January number (1893) of The Popular Science Monthly is given a *précis* of the log of the ship Savannah, which is correct; but the heading, The First Transatlantic Steamer, is totally wrong.

The Savannah was not the first transatlantic steamer, but a *sailer*, with propelling contrivances to be used in smooth water; moreover, she did not carry fuel enough to take her across to England by steam, and she proved a failure as far as transatlantic steam navigation was concerned. All this is proved by her log. The transportation of a steam engine and paddles by a sailing ship does not constitute her a steamer in the true sense of the word.

The first genuine pioneer steamship to cross the Atlantic Ocean by steam alone, and the first complete success in steam navigation, was the steamship Royal William, built at Quebec, Canada, through the enterprise of Canadian merchants, by Canadian shipbuilders, and with Canadian money. It was sent across the Atlantic Ocean in 1833, and proved to be the origin of the Cunard line of steamers. It was sold to the Spanish Government for a man-of-war and called the Isabela Segunda, being the first war steamer in the world, and was engaged in action against the Carlists. Some years later she went to Bordeaux, France, for repairs, but her hull was condemned and a new vessel was built on her model, in which the old engines were placed. This vessel went into service under the same name, but was wrecked in 1860 on the coast of Algeria, where no doubt the Royal William's engines may now be found.

I send you our Transaction, No. 20, containing the whole *attested* account of the Royal William, which is incontrovertible proof of what I say, and proves that the honor of first transatlantic steam navigation belongs to Canada and Quebec city, and not to the United States at all.

The Savannah was a fraud, a veritable sailing ship, built as such, subsequently took on an engine and propelling contrivances which could only be used in smooth water; with these she steamed *out of port*, then *sailed* to England, steaming only eighty hours, not consecutively, out of a passage of twenty-nine days and a half, but took good care to let down her paddles on coming into port, making believe that she steamed the whole way across the Atlantic, and, moreover, repeated this performance at every port she visited. The Royal William was the first veritable transatlantic ocean steamship.

F. C. WURTELE,
*Librarian of the Literary and Historical Society of Quebec.*

QUEBEC, *March* 25, 1893.

[All that Mr. Wurtele says of the defects of the Savannah appears on the face of the article we published. The title, if not strictly accurate, reflects current speech on the subject. We are glad to give our Canadian neighbors the credit that is their due in the matter of the Royal William.—ED.]

## FOOD OF THE GARTER SNAKE.

*Editor Popular Science Monthly.*

SIR: In your February number, Mr. Alfred G. Mayer, in speaking of the habits of the garter snake, says that he is not aware of their eating birds or mice. They will, when kept in captivity, at least, eat the latter animals. I once kept one under observation for a considerable time, and its only food was mice. These it ate with apparent relish and in greater numbers than I supposed at first would be eaten. Its mode of capturing and killing a mouse was also different from that by which the snakes secure frogs. It lay quietly coiled, with its head slightly elevated, for a little time after the mouse was put into the box. The latter ran to and fro over the coils of the snake, as though utterly unaware of the presence of an enemy. Presently the snake darted forward, seized the mouse in its jaws, and with lightning-like rapidity *coiled itself around its body*—the head of the snake and the mouse being invisible from without the coil. The quickness of the movement was decidedly startling. After about one minute the coils began to slacken, and the mouse rolled out, completely crushed and quite dead. The snake moved away, but within an hour devoured it. This snake was *Eutænia sirtalis*. I have not found any one else who has seen it take its food in this way, and can not account for the actions of this particular specimen. A full-grown copperhead, under similar conditions, behaves very differently. With marvelous rapidity it would shoot its head forward, apparently merely touching its victim. The mouse would give a faint squeak, and in thirty seconds would be dead and perfectly stiff. His snakeship then devoured it at his leisure.

WILBUR S. JACKMAN.

COOK COUNTY NORMAL SCHOOL, CHICAGO, ILL.

# EDITOR'S TABLE.

### *SOCIAL PROBLEMS.*

WE have read with considerable interest a book by Mr. Henry M. Boies, elsewhere noticed in this number, having for its title Prisoners and Paupers. We have read it not only with interest but with sympathy, for Mr. Boies is much in earnest, and his aim is the noble one of serving the community by checking the evils of criminality, pauperism, and mental and physical degeneration, which in these latter years have been assuming so threatening proportions. With much that the author says we entirely agree, and many of his suggestions seem to be of a very practical and useful kind. Here and there is perhaps a touch of undue national vaingloriousness which does not harmonize very well with the fact that the book is in the main a revelation of the weaknesses of American society. Here and there, too, the author seems to contradict himself, as where, on page 95, he speaks of the upward tendencies in this country being more powerful than the downward ones, and afterward (page 258) says that, while "we are listening to the delusive enchantments of physical prosperity and national growth, millions of remorseless *teredos* from the lower depths are honeycombing the hull of our ship of state"; and again (page 259) that "the condition politically is desperate, but not hopeless"; and again (page 278) that "signs of a general degeneracy are attracting public attention." The important thing, however, is that, in the statements and observations he makes, Mr. Boies gives us plenty to think about, and makes it very plain that something more than thinking is called for—that prompt, strenuous, and intelligent action is an urgent necessity of the moment.

It all amounts to this, that, while the men of this generation are eating and drinking and taking their ease, marrying and giving in marriage, running political machines, and blowing hot or cold, as the case may be, upon the stock market; while luxury is on the increase, and practical Science is recording her most magnificent triumphs, the foundations of society are being sapped by the incessant growth of unsound social elements. In early ages mankind, in only less degree than the lower animal tribes, had the benefit of the rude but effective surgery of Nature to keep them up to a certain level of physical efficiency; and in a later period the extreme severity of the laws had the effect of removing from the community large numbers of those who were least adapted for citizenship. As a result of these processes the civilization of to-day, with its more humane and philanthropic spirit, became possible; but it is now beginning to be found out that philanthropy, as heretofore practiced, is no match, so far as the physical purification of society is concerned, for the methods of Nature, as described by Malthus and Darwin, or even for the penal discipline of our forefathers. Mr. Boies fully accepts this view of the matter, as the following extract from his book will show:

"The civilized man is the product of the survival through all the ages of the strongest, most stalwart, and capable savages. In the progress of his civilization the development of the sentiment of human brotherhood and the principles of Christianity has caused an interference with the natural law provided for the extinction of the unfit by impelling the strong to maintain and care for the weak and defective. At the same time, advances in the sciences of hygiene, medicine, and surgery enable many of the unfit to survive the tests of child-

hood and disease which, in a state of nature, would be fatal. It is necessary, when humanity thus restrains the operation of the laws of Nature, that it should supply a correlative supplement to prevent disastrous consequences. If civilization and philanthropy can not permit Nature to accomplish its inexorable decrees in its own way, they must provide some other way, or finally be overwhelmed."

The practical question may therefore be very simply stated: Can a sufficient amount of public attention be concentrated on the evils that threaten us, through the disproportionate multiplication of criminals, paupers, and physically defective persons, to cause effective measures to be taken to combat those evils, and, as far as possible, extirpate their cause or causes? Mr. Boies shows clearly enough the measures to be taken, and, on the whole, we must say that we find very little to dissent from in his suggestions. He pours just denunciation on our present method of turning criminals loose upon the community after a certain term of imprisonment without the slightest guarantee, moral or other, for their future good behavior. He calls attention for the thousandth time to the evils wrought by our unwholesome methods of jail administration. "It is the unanimous testimony," he says, "of every one who is conversant with the management of county jails that they are nothing more or less than breeders of criminals, where they are, as is generally the case, committed to the superintendence of political sheriffs." Of the jails of the State of Pennsylvania—and here the author professes to speak from personal knowledge—he says: "These jails permit a promiscuous and unrestrained commingling of the most depraved and vilest professional convicts with children, accused persons, and detained witnesses, without let or hindrance. In many cases even sexes are not separated." Upon a recent visit to the jail of Sunbury, Northumberland County, the author found, among fifty-four inmates of all classes, "two bright, nice-looking boys, one thirteen and the other fourteen years old, who had been incarcerated already two months and would have to remain two months longer before trial. They were accused of stealing four bottles of ginger beer!" Along with them was a depraved and vicious-looking boy charged with attempted rape. There are, we are told, in the United States, seventeen hundred and fifty-eight county jails and only forty-four juvenile reformatories. Great Britain, on the other hand, supports over four hundred reformatories and industrial schools, and has in consequence been able to close fifty-six out of one hundred and thirteen prisons and jails within ten years. In this country during the same period there has been a constantly increasing expenditure for prisons and jails, as might be supposed from the fact stated by the author at the outset, that our criminal population has increased in almost double ratio to the general population.

The most important suggestion made by the author is, that incorrigible criminals and all the hopelessly defective members of the community who are thrown upon the public care should be segregated under conditions that shall absolutely prevent them from propagating their kind. He proposes, indeed, that the problem shall be simplified by calling in the aid of surgery "to remove or sterilize the organs of reproduction," an operation, he adds, which if "bestowed upon the abnormal inmates of our prisons, reformatories, jails, asylums, and public institutions, would entirely eradicate those unspeakable evil practices which are so terribly prevalent, debasing, destructive, and uncontrollable in them." The proposed application of this remedy will be considered by most too sweeping; but as regards incorrigible criminals, particularly those whose crimes take the form of violence and lust, it will not be

long, we believe, before public opinion will sanction its employment in their case.

The conclusion of the matter for the present is, that society is taking far too little interest in the questions which Mr. Boies so ably and earnestly discusses. It must be aroused from its easy-going indifference, or our boasted civilization will not be worth many generations' purchase. Philanthropy has taken the job of keeping up the standard of the human race out of the hands of natural selection; and it now devolves upon it to show that, aided by science, it is equal to its self-imposed task, and can indeed accomplish results that never could have been accomplished by the operation of unconscious laws.

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## LITERARY NOTICES.

Prisoners and Paupers. A Study of the Abnormal Increase of Criminals, and the Public Burden of Pauperism in the United States; the Causes and Remedies. By Henry M. Boies, M. A. New York: G. P. Putnam's Sons, 1893. Pp. 318. Price, $1.50.

Mr. Boies had peculiar facilities for the production of such a work as this and he has used them ably. In his preface he says that he has in this work not only endeavored to give a general view of the subject as it appears in this country, "to emphasize the waste of human sympathy and public funds which results from what appears to be inconsiderate and misdirected methods of treatment," but he proposes a most feasible—he says, "positive remedy."

The eleventh census of the United States, which is now being published, "furnishes statistics of a national growth in numbers, wealth, and general prosperity unparalleled in the history of civilization." Nevertheless, this census, says the author, makes some disclosures which are "appalling in the highest degree to our confidence in the future." One of these is the extraordinary increase in the criminal classes; and he shows that while in 1850 the proportion of criminals was 1 in 3,500 of the population, it increased in 1890 to 1 in 786·5, or 445 per cent; while the increase of population in the same period was only 170 per cent.

Mr. Boies claims that "such a disproportion can not continue indefinitely without a relapse into barbarism and social ruin." And he explains his statement by telling that such a condition of affairs does not exist in any other civilized nation. He attributes the first cause for crime and pauperism to the unnatural increase of intemperance; the second, "the crowding of the people to the centers."

The third cause lies in the existing laws for the punishment of criminals and the unintelligent manner in which they are administered. And having thus briefly summarized the conditions of paupers and prisoners generally and the causes for their existence, the author reviews the awful criminal condition of Pennsylvania, and in the sixth chapter begins an examination of the classes which form the prison and pauper population of the country.

In this part of the work it is stated that that portion of the population which is foreign-born, or having one or both parents foreign-born, furnishes over one third of the criminals and three fifths of the paupers of the country, whereas they constitute only one fifth of the whole number. From this the author concludes that to avert the danger "which has become imminent, and threatens our very existence, . . . Congress must regulate immigration as the initial remedy."

The excessive increase of criminals from the negro population occupies the next chapter, and the anomalous proportion of criminals among the population of African descent is so startling that Mr. Boies analyzes the causes very minutely. It appears, he says, that although "they constitute less than 13·51 per cent of the total population, yet they contribute one third of our convicts, though only 8·8 per cent of our paupers." Further on he says that this alarming increase "is quite as important and threatening as the foreign element," which has been considered. The cause for this disparity of criminals and paupers he claims is that "a ruling white minority (in the South), possessing the wealth, stands over a black majority which is paid for their labor actually less than the fairly comfortable subsistence which they received as slaves, and denies to them every right of equality. . . . This is as hostile to true Americanism as was slavery." And he continues,

that as a remedial measure, "Congress must therefore enforce . . . the protection of the colored race in the enjoyment of the rights it has conferred upon it in the face of the world."

In the chapter, Intemperance as a Cause, Mr. Boies claims that alcoholic drink is the direct or indirect cause of 75 per cent of all the crimes committed, and of at least 50 per cent of all the sufferings endured on account of poverty, and that "the terrible effects of this curse of humanity are displayed to all the elements of our population, the native, the foreign, the colored, and the urban alike." As one of the remedies against intemperance he suggests the establishment of cheap coffee and tea houses and social halls, after the fashion of those established by the Salvation Army in England; and he adds that "as the way to a man's heart is through his stomach," give him good, cheap food, and his desire for stimulants will cease.

The author entirely disapproves of the present general conditions of the arrest, prosecution, and imprisonment, or rather the manner of imprisonment, of criminals. He claims that the penal code should be reorganized, and that more consideration should be shown to "youthful delinquents;" for "county jails are nurseries of crime," and he attributes this to the "wrong management of the prisoners." "No State," he says, "should tolerate" "the infamous jails as they at present exist in county towns." And, "until the whole penal system is reorganized upon the basis of common sense," he offers some excellent suggestions as to the segregation of the different types of prisoners—the one from the other, as well as to how the number of prisons could be and should be lessened.

The work is illustrated with fourteen plates, and is a most valuable addition to the social and economic literature of the nation.

The Great Commanders Series. Edited by General James Grant Wilson. New York: D. Appleton & Co.

Admiral Farragut. By Captain A. T. Mahan, U. S. N. Pp. 333. Price, $1.25. —General Taylor. By General O. O. Howard. Pp. 386. Price, $1.50.—General Jackson. By James Parton. Pp. 332. Price, $1.50.

The issue of what gives promise of being a very attractive series of biographies has been begun under the above general title. The first volume is a life of Admiral Farragut. The career of the most celebrated of America's naval heroes is sufficiently picturesque to warrant its being given the leading place. Captain Mahan's account of it is of a popular character, being neither a monograph on naval warfare on the one hand nor a juvenile story on the other. A few pages suffice to tell of Farragut's parentage, birth, and his meeting with Commander Porter, which determined the course of his life. His boyhood, before the beginning of his naval career, was too brief for much incident, for his warrant as midshipman dates from the middle of his tenth year. The record proceeds with Farragut's first cruise on board the Essex during the War of 1812. A dozen somewhat eventful years followed, bringing the young man to the rank of lieutenant. The years from 1825 to 1860 take comparatively little space, for they represent mostly the routine service of a naval officer in time of peace. Then come his grand achievements in the civil war—the New Orleans expedition, the operations at Vicksburg and Port Hudson, and the entrance of Mobile Bay. These events are described with much detail and vividness, and the several operations are illustrated by charts. A short chapter is devoted to the admiral's five years of life after the war, and a sympathetic estimate of his character closes the volume.

In the life of Zachary Taylor is given a record rich in those details which often reveal more of the subject's character than his most formal and deliberate acts. We have a glimpse at his early life in the frontier territory near Louisville, Ky., then an account of his first few years in the army, his service in the Northwest Territory during the War of 1812, his campaigns against the Indians in Florida and elsewhere, all leading up to his magnificent achievements in the Mexican War. His part in this contest is described in a sympathetic and picturesque manner. Close upon the heels of it comes his election to the presidency, and a sketch of his administration, of little over a year, brings his life to a close.

In James Parton's biography of Jackson is seen the hand of a master historian. Vigorous, as befits the history of such a strong personality, it is everywhere judicious, faith-

ful, and conscientious. Jackson's faults and autocratic acts are not concealed, while his sterling qualities and remarkable achievements are set forth in due prominence. The account of Jackson's campaign in defense of New Orleans is given large space in the volume. It is told with much vivid detail, and has the fascination of a tale of brave and forceful deeds, which it is. This book is notable, too, as being the last literary labor of its author, who passed away two months after it was completed.

The series is to be continued with lives of Washington, Greene, Sherman, Grant, Lee, and many others.

The Industrial Arts of the Anglo-Saxons. By the Baron J. De Baye. Translated by T. B. Harbottle. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1893. Pp. 135, 4to. Price, $7.

This work, which is illustrated with thirty-one cuts in the text and seventeen full-page engravings, although of considerable value to archæological students, does not shed much ethnographic light. As a matter of fact, all attempts at an arrangement of antique arts and industries must to a certain extent be arbitrary and artificial, as chronological classification *can not* be fully carried out in the present condition of archæological research. Baron de Baye claims that the Jutes occupy the first place, chronologically, among the invading barbarians of Great Britain. The Saxons and Angles followed soon afterward, and, according to the author, they all settled in Kent, in which county the most perfect archæological specimens of the ancient Anglo-Saxon industries are found. The baron uses Eutropius, Ptolemy, and Tacitus very freely in his proofs of the German ancestry of the early Britons; but it is an incontestable fact that long before the advent of the Anglo-Saxon barbarians, the Kelts, who were settled in Ireland, had made incursions into England. The archæological specimens of Anglo-Saxon industries which are illustrated in the beautiful volume we have under observation clearly resemble the accepted evidences of an earlier industrial condition among the Irish Kelts, and, more distinctly than the authorities quoted by Baron de Baye, assert their parentage as Keltic and not Germanic.

Apart from this too frequent error of the ethnographer, the author has compiled a very valuable addition to the archæological literature of England. The chapters on Anglo-Saxon fibulæ are not alone interesting but important, although they stamp the evidence of origin as Scandinavian rather than German. In these chapters the author proves with tolerable clearness an archæological point which has occupied the attention of *savants* for centuries, for he shows that the fibulæ which have been discovered in Kent and the Isle of Wight are of continental origin, and precisely similar in construction to the ornaments of Gothic manufacture which have been found in the barbarian cemeteries of the continent. This discovery at once establishes a proof of intercourse, and illustrates the artistic influence exerted over that part of Britain which was near to France; while in other parts of the work we have, upon comparison with the catalogue of the Museum of the Royal Irish Academy, distinct evidences of a Keltic origin for the industrial arts of the early Britons.

The author's analysis of the uses of the beads and crystal balls which have been found in the graves of the Anglo-Saxons is very interesting. In Nenia Britannica it is claimed that they were used for occult purposes, whereas Mr. Roach Smith is of opinion that "all the objects exhumed are capable of a perfectly simple explanation." Baron de Baye, however, asserts with somewhat of authority that they were used as talismans against sickness and "to neutralize the force of the enemy's blows." The work is excellently printed and got up, and the plates and references will be found to be of exceeding interest to ethnographical students.

Faith-healing, Christian Science, and Kindred Phenomena. By J. M. Buckley, LL. D. New York: The Century Company. Pp. 308.

Besides the subjects named in the title, those of Astrology, Divination, and Coincidences; Dreams, Nightmare, and Somnambulism; Presentiments, Visions, and Apparitions; and Witchcraft, are treated of in this volume. In his discussions the author has adopted certain principles as working laws,

namely: "That before endeavoring to explain how phenomena exist it is necessary to determine precisely what exists; and that so long as it is possible to find a rational explanation of what unquestionably is, there is no reason to suspect, and it is superstition to assume, the operation of supernatural causes." His course, therefore, is to ascertain the facts and find a common-sense explanation for them. In investigating phenomena, some of which it is claimed are connected with religion and others with occult forces, it is necessary to proceed without regard to the question of religion. We look more closely at the chapters on Faith-healing and Christian Science and the Mind Cure as relating to the most vital subjects. In questions of faith-healing allowances must be made for the operation of natural causes, unobserved or concealed, for the excited minds of witnesses, and for other circumstances that mask the real facts; but, after all deductions have been made, the author believes it must be admitted that "most extraordinary recoveries have been produced, some of them instantaneously, from diseases in general considered incurable by ordinary treatment, in others known to be curable in the ordinary process of medicine and surgery." The cases remaining to be accounted for are those in which the effect is unquestionably produced by a natural mental cause, and those in which the operation of occult causes is claimed. In these cases, of both classes, subjective mental states are important factors. With or without belief they can produce effects either of the nature of disease or cure. Active incredulity is often more favorable to sudden effects than mere stupid, acquiescent credulity. Surprise at seeing an unexpected effect may lead the mind to succumb to the dominant idea. Concentrated attention, with faith, can produce powerful effects; may operate efficiently in acute diseases, with instantaneous rapidity upon nervous diseases, or upon any condition capable of being modified by direct action through the nervous or circulatory system. Cures may be wrought in diseases of accumulation with surprising rapidity where the increased action of the various excretory functions can eliminate morbid growth. Certain inflammatory conditions may suddenly disappear under similar mental states, so as to admit of helpful exercise; which exercise, by its effect upon the circulation, and through it upon the nutrition of diseased parts, may produce a permanent cure. The mind cure, apart from the absurdities associated with it, and from its repudiation of medicine, has a basis in the laws of Nature. The pretense of mystery, however, is either honest ignorance or consummate quackery. All the practitioners are unable to dispense with surgery where the case is at all complex and mechanical adjustments are necessary, and they can not restore a lost member; but in certain displacements of internal organs the consequence of nervous debility, which are sometimes aided by surgery, they sometimes succeed by developing latent energy through mental stimulus. The claims of Christian faith-healers to supernatural powers are discredited by facts which are cited; and faith cure, technically so called, as now held by many Protestants, is pronounced "a pitiable superstition, dangerous in its final effect." It is harmful because it tends to produce an effeminate type of character which shrinks from pain, and to concentrate attention upon self and its sensations. It sets up false grounds for determining whether a person is or is not in favor with God; it opens the door to every superstition. Practically it gives support to other delusions which claim a supernatural element. It diminishes the influence of Christianity by subjecting it to a false and inconclusive test; diverts attention from the moral and spiritual transformation which Christianity professes to work; destroys the ascendency of reason; and irresistibly tends, in some minds, to mental derangement. "Little hope exists of freeing those already entangled, but it is highly important to prevent others from falling into so plausible and luxurious a snare, and to show that Christianity is not to be held responsible for aberrations of the imagination, which belong exclusively to no race, clime, age, party, or creed." The relation of the mind-cure movement to ordinary medical practice, Dr. Buckley concludes, is important. "It emphasizes what the most philosophical physicians of all schools have always deemed of the first importance, though many have neglected it. It teaches that medicine is but occasionally necessary. It hastens the time when patients of dis-

crimination will rather pay more for advice how to live and for frank declarations that they do not need medicine than for drugs. It promotes general reliance upon those processes which go on equally in health and disease. But these ethereal practitioners have no new force to offer; there is no causal connection between their cures and their theories. . . . Recoveries as remarkable have been occurring through all the ages as the results of mental states and Nature's own powers."

A Dictionary of Terms used in Medicine and the Collateral Sciences. By the late Richard D. Hoblyn, M. A. Oxon. Twelfth edition. Revised throughout, with numerous Additions, by John A. B. Price, B. A., M. D., Oxon. New York: Macmillan & Co. Pp. 822. Price, $2.25.

The appearance of the twelfth edition of this dictionary, with revisions and additions, which include even the terms used in the very modern science of bacteriology and bring the book fully up to date, places a useful work at the disposal of physicians and students. It is, of course, not exhaustive; but it contains descriptions of all the ordinary terms relating to medicine, and these, although necessarily brief, are full enough for all practical purposes. Under the head of poisons, eight or nine pages are devoted to a classification of the commoner ones, in which the symptoms and most approved methods of treatment are given.

Its small size and good print make the contents of the volume readily accessible, and the names on the title-page are sufficient guarantees of accuracy.

A Manual of Practical Medical and Physiological Chemistry. By Charles E. Pellew, E. M. New York: D. Appleton & Co. Pp. 314. Price, $2.50.

With the recent attempts to regulate the conferring of medical degrees by means of State legislation has come a tendency in the more prosperous medical schools to make their curriculums even more extended than the law requires. One of the most important innovations in this line has been the incorporation into the regular courses of a system of laboratory work, by means of which each student is given facilities for the actual chemical and microscopic study of the proximate principles, the elements entering into the composition of the human body and its secretions, and the reactions and histological characteristics produced by various pathological conditions, which are of value in diagnosis. The study of these subjects, in a practical way, has until quite recently been confined, in this country at any rate, to a few physiologists and post-graduate workers, so that an elementary text-book suited to less practiced students became a necessity. Mr. Pellew's book was designed to fill this need. Its treatment of the subject is neither original nor exhaustive, but it is very well adapted to the use of elementary students. It is printed on heavy paper, and contains several well-prepared plates and numerous line drawings.

Ethnographische Beschrijving van de West en Noordkust van Nederlandsch Nieuw-Guinea (Ethnographical Description of the Western and Northwestern Coasts of Dutch New Guinea). By F. S. A. de Clercq and J. D. E. Schmeltz. One vol., 4to, pp. 300, plates xlii. Leyden: P. W. M. Trap.

This magnificent work describes the collections made by Mr. F. S. A. de Clercq in New Guinea in the years 1887 and 1888, which are now in the Royal Ethnographic Museum at Leyden, Holland. The descriptive portion of the work is mainly by Dr. J. D. E. Schmeltz, conservator of the museum. The book is a model of its kind. It is furnished with a full list of all authorities quoted, a list of all places mentioned, an excellent map, and admirable indices—all necessary, but, unfortunately, often omitted in ethnographic writings.

The main portion of the work is divided into three parts. In the first we have a description of each object—size, form, material, details, and provenance—with references to passages in any author where similar objects have been described or illustrated. Where necessary for comparison or illustration, sketches are introduced into the text. The objects described are divided into five groups: *a*, dress and adornment; *b*, houses and domestic utensils; *c*, objects used in trade, fishing, etc.; *d*, weapons; *e*, objects used on festal occasions, ceremonies, etc. The plates, more than forty in number and mostly colored, represent the objects de-

scribed admirably. Among some of the more striking and interesting may be mentioned handsome headdresses of feathers, ear decorations of tortoiseshell, boar-tusk and red-bean breastplates, stone pounders for sago, paddles, drums, spears barbed along both edges, narrow shields elaborately decorated with carving and color, quaint carved figures, and wooden headrests or pillows. Two plates are devoted to portraits showing hairdressing, tattooing, and face ornaments. The coloring of the plates is done in Trap's best style. The second part of the work is a study in geographical distribution of the objects. A brief ethnographic sketch of New Guinea (based on Serrurier's classification) is presented. Four tables are then given in which the distribution of each type of objects is shown, and the fact is made plain that there are distinct areas of culture in the great island. A study of some ten pages follows upon the relationships shown by the ornamentation of the various objects. In 1884 Van Rye prepared a complete bibliography of New Guinea; in Part III of this work Dr. Schmeltz completes this to the present date.

Messrs. de Clercq and Schmeltz are to be congratulated upon their work. The Netherlands Government is also to be greatly commended for the encouragement and aid which it has given to its publication. Public interest in ethnography is keen and intelligent in Holland.

Geological Survey of Missouri. Vol. II: A Report on the Iron Ores of Missouri. Pp. 365. By Frank L. Nason, Assistant Geologist. Also Vol. III: A Report on the Mineral Waters of Missouri. Pp. 256. By Paul Schweitzer, Assistant Geologist. Published by the Geological Survey, Jefferson City, 1892.

These volumes, which are issued by Arthur Winslow, State Geologist, are exhaustive treatises upon the subjects of their titles. Mr. Nason complains in his preface that the lack of railroads and good public roads made the survey difficult; but, nevertheless, his patient work, assisted by the cooperation of the intelligent citizens of the iron-ore districts, enabled him to compile a most interesting as well as valuable report.

In Chapter X of the Report on the Mineral Waters of Missouri Prof. Schweitzer makes some very interesting comparisons between the domestic waters and the mineral waters of Europe, which will be read with profit by those engaged in the merchandising of the Missouri waters. In these comparisons, the author was largely assisted by the observations of Prof. Arthur Winslow. Both volumes are elaborately illustrated. Embodied with Vol. III is a very useful appendix, containing a bibliography of mineral waters, chronologically arranged.

The Mound-Builders: their Works and Relics. By Rev. Stephen D. Peet, Ph. D. Vol. I, illustrated. Chicago: Office of the American Antiquarian. Pp. 370.

Dr. Peet claims that man's first appearance on the American continent was not contemporaneous with but toward the close of the Glacial period—about ten thousand years ago. As to the appearance of this prehistoric individual he quotes other students of the subject to prove that the great French archæologist is in error when he claims that man, immediately after the Glacial period, was "of great stature." His research enables him to corroborate Dr. Thomas Wilson's summing up of the characteristics of palæolithic man, viz., "He was of short stature and strong of limb."

The author says, in his first chapter, that "In Great Britain . . . we go back of the Celts and Saxons to find the Britons and the Basques, who were comparatively modern." This is an error. Authentic records prove that not only were the Celts pre-Briton, but that the nomenclature of England was derived from the Celts of Ireland and Scotland, and was, at that time, precisely similar.

The chapter entitled The Stone Grave People is of important interest. In this the author devotes several pages to an analysis of the mound-building theory as it applies to America; and from the specimens of pottery that have been taken from the stone graves he builds a probable and interesting presumption of the facial characteristics of the prehistoric dwellers on this continent. In another chapter he seems to recede from his contention that the first appearance of man in America was after the Glacial period; for he accounts for the scarcity of images, etc., in the South by the assumption that during the dissolution of the glacial forma-

tion the mastodon retreated northward, and man—"the hunters"—followed.

The chapters on the Migrations, Village Life, and Defensive Works of the Mound-builders will be read with considerable pleasure and benefit by archæological students. Dr. Peet has given the results of his research in a style that will be acceptable even to non-students. The work is profusely illustrated.

Practical Pocket-book of Photography. By Dr. E. Vogel. Translated by E. C. Conrad, F. C. S. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1893. Pp. 202. Price, $1.

Photography now exerts such an influence upon current literature and general events that a handbook such as that which Dr. Vogel has produced is not alone timely, but useful. One of the great difficulties under which beginners in the art of photography labor is the fact that the formulas and instructions in most guides are too many, too complex, and too incomplete. In this little volume the author has selected only the simplest and best formulas for developers, intensifiers, etc., all of which have been accepted and are used by the professors of the Royal Technical High School of Berlin.

The first chapter is devoted to an examination of the different photographic apparatus in vogue among German experts, and contains also some very useful information on photographic objectives, or the combinations of lenses that are capable of giving an optical image. Instantaneous photography is also treated in this chapter, and some simple rules by which exposures should be determined will be read with profit by both amateur and professional photographers. Among the formulas for developers, the author draws attention to a new and concentrated para-amidophenol developer, which, under the name of "rodinal," has been introduced by the Aktiengesellschaft für Anilinfabrikation. This developer only needs dilution with water to be ready for use, and "is especially excellent for instantaneous photographs."

In the fifth part of Chapter IV, Dr. Vogel gives some very simple instructions for the recovery of silver from residues, which will be useful for those who use developers, intensifying baths, etc., in large quantities. The fifth chapter is devoted to the positive processes, which are examined in brief detail.

The book is illustrated fully, and the selection of cuts and diagrams is admirably suited to the subject matter. The translator has added some important foot-notes to the general text, which was evidently written for the use of German students by Dr. Vogel.

Mineral Springs and Health Resorts of California. By Winslow Anderson, M. D. San Francisco: The Bancroft Company. 1892. Pp. 384.

Having regard to the value of the investigation of balneotherapy and the scientific internal administration of mineral waters, which has gone on with great benefit in Europe for centuries, Dr. Anderson, believing that California possessed valuable mineral springs, spent several years examining and comparing the waters of that State, and gives the result of his labors in this work. It is a perfect revelation of the mineral waters of California, and apparently leaves nothing unsaid either as to their efficacy as health restorers or of their comparative value against well-known European mineral waters. Although the greater part of the work is devoted to an exhaustive analytical examination of the waters, a fund of useful information is added on the ancient uses of mineral springs, their classification, and the theory of their origin, with the therapeutics or medicinal uses of the different waters. The book is profusely illustrated with cuts of the mineral springs and of California's most famous health resorts.

Elementary Text-book of Entomology. By W. F. Kirby, T. L. S. Second edition. London: Swan, Sonnenschein & Co. New York: Macmillan & Co. 1892. Pp. 281. Price, $3.

This work is elaborately got up, containing eighty-seven plates and over six hundred and fifty figures, representing a pictorial library of the insect world. In his introduction Mr. Kirby gives an unusually lucid explanation of the structures and zoölogical nomenclature of the insect tribe, which he divides into four classes of animals having bodies composed of a number of joints or segments. He pays reverent tribute to the researches of Linné, who divided all the insects known

to him into seven orders in his work Systema Naturæ (1735). Fabricius (a pupil of Linné) prepared a new classification of insects, founded on the structure of the mouth, and he renamed all the Linnæan orders, even where they coincided with his own.

From these and other sources Mr. Kirby selects only the nomenclature that is modernly accepted, and he gives a most interesting study in this volume. The chapters on the *Hymenoptera* class will be found to be of more zoölogical value than any account of the habits of bees, wasps, ants, etc., that has yet been published; and as this family is, industrially, of more consequence to the public than any other of the insect class, the selection of the *Hymenoptera* species for his most elaborate history is well chosen.

The analysis of the *Lepidoptera* family is treated very exhaustively. It comprises especially butterflies and moths, and the plates at the end of the book very fully illustrate the principal members of the species.

The Student's Handbook of Physical Geology. By A. J. Jukes-Brown, B. A., F. G. S. Second edition, revised. London: George Bell & Sons. 1892. Pp. 666. Price, $2.25.

This is a recast of Mr. Jukes-Browne's Handbook of Geology, to which he has added over one hundred pages, chiefly dealing with physiographical geology and the substructure of the earth's crust. He shows pretty clearly that, although physiographical geology is in the nature of an incidental study, it is nevertheless the most perfect basis upon which to form accurate geological beliefs, and he places this part of the work, very properly, immediately following the chapters on Dynamic and Structural Geology.

Perhaps the most interesting section of the work is that devoted to the underground circulation of waters. The mechanical effects of this subterranean water circulation are very important in geological research. In England and in many parts of the Continent and America they usually consist of landslips and cave formations; whereas in Ireland and in southern Germany the shell of land above the water is oftentimes "cracked," and, becoming detached from its moorings, travels a mile or two from its original location.

In the chapter on Igneous Rocks as Rock Masses, Mr. Jukes-Browne has given some highly interesting examinations of the porphyritic deposits of Wales, Scotland, and Ireland, clearly indicating the volcanic structure of these countries. In dealing with the influence of earth movements, the author quotes Prof. Powell in connection with the probable system and time of the bed formation of Colorado, and he says: "All the facts concerning the relation of the waterways of this region to the mountains, hills, cañons, etc., lead to the inevitable conclusion that the system of drainage was determined antecedently . . . to the formation of the eruptive beds (lavas) and (volcanic) cones." The work is profusely illustrated.

The Earth's History. An Introduction to Modern Geology. By R. D. Roberts, N. A. New York: Charles Scribner's Sons. 1893. Pp. 270. Price, $1.50.

This is a useful little volume, giving an interesting sketch of the methods and chief results of geological inquiry; but the author errs, in the same manner that do most English scientists and writers of scientific English bibliology, inasmuch as that he assumes that "the geology of Great Britain is indeed, in epitome, the geology of the world." In his preface he says that although individual groups of rocks may be found developed on a grander scale in one or other of the continental areas, and that "particular scenic features, more majestic and impressive, may be found elsewhere; in no part of the world can so great a variety of geological phenomena (no doubt often in miniature), and so complete a system of natural agencies, either in active operation or displayed in their results, be observed than in Great Britain." The recent geological surveys of Arizona, California, and other American States had not apparently reached London when Mr. Roberts wrote his book, for in the ascertained stratigraphical conditions of these States we have a far more generous field for geological research than the well-ventilated analysis of British geological conditions can ever display. Nevertheless, the author has compiled a valuable text-book of preliminary examination of the study of geology, and in the chapters upon Aqueous Rocks and the Deposition in Past Times, and the Volcanic

Action in Past Times, he has materially added to the existing literature upon geological research.

Three books in the series of *English Classics for Schools*, by the American Book Company, well illustrate the excellent idea on which the issue is based—which is that of presenting the best English books, of suitable size, with the accompaniment of full prefatory information concerning the subjects, environments, and authors of the works. The *Sir Roger de Coverley Papers from the Spectator* is introduced with an account of the Tatler, of which the Spectator was the direct outcome, and its characteristics, and biographical sketches of *Addison*, *Steele*, and *Budgell*, the authors of the Sir Roger de Coverley papers. To a similar edition of *Sir Walter Scott's Marmion* are prefixed a characterization of Scott's work in the poem, a description of the Scottish people of the time of the action, their customs and distinctions, an account of the significance of the battle of Flodden Field, and maps of the region and of the battle-ground. *The Second Essay on the Earl of Chatham*, by *Lord Macaulay*, is furnished with biographical sketches of the author and of William Pitt. These volumes are neat in appearance, moderate in price, and are suitable for the modest library as well as for the schoolroom.

*Robinson's Arithmetics* (American Book Company) have for many years had a wide use among the best American schools. In preparing new and revised editions, the object has been kept in view of retaining all the features which have contributed to their usefulness and popularity, and making only such changes as would add to their value and bring them up to date. In the *Primary* work, stress is laid upon teaching pupils to recognize numbers of objects before they are required to represent numbers by words or by figures. A valuable feature of the revision of the *Rudiments* consists in the addition of about forty pages of introductory exercises, of a general character, which adapt the book for use in a two-book series, in connection with the *Practical Arithmetic*, or it may be used without the introductory exercises, in a three-book series. The scheme of revision of the *Practical Arithmetic* has been rather one of judicious addition than of omission, and yet by an economical adjustment and by an occasional dropping out of useless matter it has been possible to add many valuable features and much new matter without materially increasing the size of the book. In the arrangement of subjects attention has been paid to placing those in sequence which run naturally and by easy stages into one another, and to giving early places to the most important and useful applications.

*Ædeology*, by *Dr. Sydney Barrington Elliot*, is devoted to the physiology, hygiene, etc., of the generative life of man. The volume is compiled from a great variety of sources, and is characterized by that vague generality of statement which appeals to a prurient curiosity without doing much for the enlightenment of the reader. Full and explicit instruction in the physiology of the generative system, suitably timed and adapted in the education of the young, would be of great service to society, and there is nothing in this class of publications that will take the place of it or approach it in value. (New York, St. Clair Publishing Co., 260 pages; price, $1.50.)

In the sixth edition of M. Foster's *Text-book of Physiology*, the appendix by Dr. *A. Sheridan Lea*, on *The Chemical Basis of the Animal Body*, is bound by itself as Part V (Macmillan, $1.75). It has been enlarged, and now constitutes a treatise on the chemical substances occurring in the animal body. The several classes of proteids are first described, after which the chemistry of the enzymes, or soluble unorganized ferments, is given. Certain amorphous bodies allied to proteids—mucin, gelatin, keratin, etc.—and the few carbohydrates found in the human body then receive attention. Other groups are the fatty acids and their allies, the amides and amido acids, the uric-acid group, the ptomaines, and the various coloring matters. Cuts showing the appearance of crystals of many of the substances described are scattered through the text, and the volume has a separate index and a list of authorities quoted.

A treatise on *Varicocele and its Treatment* has been prepared by Prof. *G. Frank Lydston*, M. D. (Keener). After a description of the disorder, its causes are reviewed, and

various modes of treatment, palliative and radical, are set forth. The volume has an index and a bibliography. A number of cuts illustrate the appearance of diseased parts and methods of operation.

*Studies in American History*, by Prof. *Mary Sheldon Barnes* (Heath, 60 cents), is a teachers' manual, consisting of a series of outlines for lessons. It is designed to direct pupils in studying history from the original materials, and to that end gives lists of authorities, with critical comments, summaries of points to be made under each head, notes, suggestions, and references for the teacher's reading. The studies are divided into seven groups, one being introductory and the others covering the history of the territory occupied by the United States from Columbus to 1892. Machine teachers had better let this book alone; it is a tool they can not handle.

An *Elementary Treatise on Trigonometry*, by *E. W. Hobson* and *C. M. Jessop*, has been issued from the press of Cambridge University (Macmillan, $1.25). It is a book for beginners in its subject, and parts are indicated which students are advised to pass over until they have been once through it. A large number of problems are given, many of them practical, and the answers are put at the end of the volume.

Having received from Prof. Kükenthal for examination some specimens of *Apus* brought from Spitsbergen, Mr. *Henry Meyners Bernard* has made a study of the species and come to the conclusion that it is a variety of *Lepidurus glacialis*, which he proposes to call *L. Spitzbergensis*. His observations of this *Apus* form Part I of a book, *The Apodidæ*, which he has contributed to the Nature Series (Macmillan, $2). In Part I, also, he undertakes to prove that *Apus* is an original crustacean easily derivable from an annelid. Going on, in Part II, the author maintains that *Apus* is, moreover, the original of all the modern crustaceans.

*The Heredity of Acquired Characters* is the title of a paper by Dr. *Manly Miles*, Lansing, Mich., which was published in *The Proceedings of the American Association for the Advancement of Science*. The inheritance of acquired character has been denied by Weissman, who claims the "continuity of the germ plasma as originally formulated, and all inheritable variations are assumed to be the result of fortuitous changes in the reproductive germs." Dr. Miles claims that it is impossible that a living substance, undergoing constant changes, can be "a substance of extreme stability" to "grow enormously without the least change in its molecular structure," as advanced in Weissman's theory, and he adds that the fact of the germ plasma being brought into intimate relations with the metabolism of the body plasma, the habits of the organism in modifying the general metabolism of the body must also exert an influence on the system of the germ cells, and, through their constantly changing substance, on the forms of activity that are transmitted from one generation to another. From Dr. Miles's standpoint it is an almost impossible supposition that from two germs of identical qualities and tendencies, two adult forms could be evolved, precisely alike in every detail. To arrive at such a perfect reproduction it would be necessary to have the same series of anastates in the constructive processes of every organ, and the same destructive metabolism throughout the entire period of growth, which, of course, could very rarely occur in the surrounding conditions of two individuals; but he admits that the repetition of an acquired habit for several generations, uniformly transmitted, might establish a dominant, inherited family characteristic.

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## POPULAR MISCELLANY.

**The Telautograph.**—A new system of electric transmission was recently exhibited in New York and Chicago which promises to rival in commercial importance the telephone. This is the writing telegraph of Prof. Elisha Gray. By means of it any one can with an ordinary lead pencil on ordinary paper write a message or make a sketch and have it reproduced with exactness, in its minutest detail, in the receiving instrument, which may be hundreds of miles away. As this method of communication necessarily provides a record, and as the mistakes so easily possible in any system of oral communication can not occur, it should find a wide field of usefulness in the business world. *Fac-simile* telegraphs are almost as old as the art of telegraphy itself, but no such system has heretofore come into extended use, as they have proved unreliable in practice and have lacked the simplicity essential in any apparatus designed for general use. Nearly all previous attempts to provide autographic reproduction have depended upon synchronism

in the movement of the transmitting and receiving instruments, a condition practically impossible of realization. Unlike these earlier devices, the system of Prof. Gray does not depend at all upon the timed movements of the instruments at each end of the line, but like the telephone the transmitter positively actuates the distant receiver. The fundamental principle of the apparatus is that first applied to this purpose by Mr. E. A. Cowper, of England, some fifteen years ago; but Prof. Gray has greatly simplified the construction and given a range and flexibility to the instruments which practically constitutes a new departure in this method of transmission. The principle involved is the familiar geometric one that any plain curve, no matter how intricate, may be decomposed into component parts along two lines at right angles to each other. If, then, a point be affixed at the junction of these lines, all that is necessary to reproduce its movements is to cause two other similar lines to reproduce the movements of the first two. A point at the junction of the second lines will then travel in exact conformity with the first point. This principle is made use of in the familiar draughtsman's instrument, the pantograph, used for producing enlarged or reduced copies of an original drawing. In Prof. Gray's apparatus the transmitting instrument consists of a box provided with a leaf or table, upon which the paper, which is fed from a roll mounted upon the instrument, rests. The pencil is placed at the junction of two silk threads at right angles to each other, the farther ends of which are wound upon drums in such a way that the motion of the pencil serves to rotate them backward and forward in exact accordance with the linear components of the curves described by it. These drums have each an arm which sweeps over a series of electrical contacts, thereby sending a succession of electrical impulses into its line wire proportional to its movement. A contact playing between stops serves to reverse the current with the reversal of the motion of the drums. The receiving instrument consists of a pen mounted at the junction of two light metal arms, the movements of which are controlled by the electrical impulses sent to line by the transmitting mechanism. This control is effected by means of a gear-wheel—one for each metal arm—which is actuated by clutch-weights, which weights are in turn controlled by the current through the medium of an electro-magnet. The gear-wheels, therefore, move in one direction or the other in exact accordance with the currents sent over the line wires and give motion to the arms carrying the transcribing pen. The pen is of the ordinary form in such instruments, namely, a glass tube drawn out to a capillary bore near the point and supplied with a free-flowing ink.

**Relations of Leaves and Roots.**—As a result of investigations of the influence of manure on the development of roots, M. Dehérain has found that roots in unmanured ground have a larger growth than in manured, having to spread more in search of the scanty nutriment. It having been previously found that transpiration largely depends on the activity of the roots as well as on the evaporative surface, and is not, therefore, strictly proportional to leafy development, it follows that if a plant with small leafy growth evaporates relatively more water than one with more abundant foliage, it is probably due to large root-growth procuring more water. Volkens has observed that desert plants have extraordinarily long roots. M. Dehérain further points out that solar rays falling on a plant have the twofold work of assimilation and transpiration to perform, and that these are complementary. In strong, leafy plants, assimilation is vigorous, so that transpiration is limited; while in the leaves of an "anæmic" plant a large fraction of the solar energy is given to transpiration.

**Folk Lore of the Kootenay Indians.**—Among the Kootenay Indians of southeastern British Columbia there exist some strange ideas of mythology. Their folk lore is extremely picturesque, and bears strong resemblance to that of the earlier European and Asiatic races. The moon is regarded by them as a man, and the sun (*natā-nik*) as a woman. There was no sun in the beginning (according to the Kootenay Indian mythology), but after the Indians had vainly endeavored to discover it, the coyote was successful in making it rise above the mountains. Another version makes the chicken-hawk cause the sun to rise, and the coyote,

getting angry, shoots an arrow which misses the sun, and causes the prairie to take fire. The man in the moon is an Indian, who chopped wood every day, *including Sunday*, whereupon the moon came down and seized him, and he has been up there ever since. In the same manner the stars are supposed to be Indians, who have "got up into the sky" from time to time; thunder is caused by a great bird, and the lightning by the arrows which it shoots. Their version of the flood is a very quaint piece of folk lore, and apparently entirely original with them. In a report of the British Association for the Advancement of Science, on the Northwestern Tribes of Canada, Mr. A. F. Chamberlain describes this legend very interestingly, and in his pamphlet, which covers almost every trait and characteristic of the Kootenays, as well as statistics of the development of their language and customs, he relates the strange history of their sociology, folk lore, physical characteristics, etc. The monograph is published at the offices of the association at Burlington House, London.

**Animals for Pets.**—What is required for an every-day pet, says the London Spectator, is that it shall be beautiful and intelligent; that it shall neither be too large nor too delicate; and, if a bird, that it shall sing or talk —preferably both. The limits set by size and constitution are the main consideration in the choice of pets. Yet even so, the possible range is very great, and might well extend far beyond the species which form the main body of those usually seen at home. Tame rabbits are plenty, but tame hares are rare. A charming little foreign pet for the house is the suricate, "an active and vivacious little fellow, some ten inches long, with greenish-brown fur, large bright eyes, a short pointed nose, and dainty paws, which, like the squirrel's or the raccoon's, are used as hands, to hold, to handle, and to ask for more. . . . The creature is made for a pet, and is so affectionate to its master that it can undergo any degree of 'spoiling' without injury to its temper." A larger and more beautiful creature is the brown opossum from Tasmania —the "sooty phalangist"—with fur of the richest dark brown covering its prehensile tail like a fur boa. "Its head is small, with a pink nose and very large brown eyes; and it has a 'compound' hand, with claws on its fingers, and an almost human and clawless thumb, with the aid of which it can hold a wineglass, or eat jam out of a teaspoon. That owned by the writer was, without exception, the most fearless and affectionate pet he has ever known. In the evening, when it was most lively, it would climb on to the shoulder of any of its visitors, and take any food given it. It had a mania for cleanliness, always 'washing' its hands after taking food, or even after running across the room, and was always anxious to do the same office by the hands of any one who fed it. It made friends with the dogs, and would 'wash' their faces for them, catching hold of an old setter's nose with its sharp little claws, to hold it steady while it licked its face. The staircase and banisters furnished a gymnasium for exercise in winter, and in summer it could be trusted among the trees in the garden." The American gray squirrel, the coati, the mongoose, the marmot, and the prairie dog are commended as pleasant pets in their various ways; but only one monkey—the capuchin—is thoroughly recommended as an indoor pet. No other monkey approaches it in good temper and pretty, winning ways. They all have good, round heads, with black fur on the top and light brown on the cheeks. Their faces are most expressive and seldom still, for they take deep and abiding interest in everything in or about their cages. One is mentioned which had learned to put out burning paper by beating it with its hands or knocking it against the floor. Another, if it got a match, would collect a heap of straw, strike the match, light its bonfire, and dance around it. "The capuchin is so small, so pretty, and so clever that it seems to embody all the good and none of the bad points of monkey nature."

**Spinal Curvature in Schools.**—The result was recently presented by Dr. Scudder, of Boston, of an investigation into the seating of thirty-five hundred schoolgirls, with especial reference to its effect on the spine. Lateral curvature of the spine, the author said, is probably due to several factors, among which are the weight of the body falling upon a weakened spine; weakness of the spine in bone, muscle, or ligament; and a position persistently out of the median antero-poste-

rior plane of the body. The author had made a careful examination of the seating in schools, and found that faulty positions are certainly induced because of the lack of adaptation of seat to pupil and of pupil to seat. It was not possible to say how much of a factor poor seating is in causing lateral curvature, but there could no longer be any doubt that it plays an important part. He favored as a counteractive measure the introduction of general neutral movements tending to develop the whole child along the lines of his natural muscular evolution, or exercises like those of the Swedish gymnastic system. Some of the participants in the discussion of the reading of the paper suggested that faulty school attitudes might be less potent in producing curvature than bad habits acquired independently of them. All agreed upon the utility of suitable exercise as a counteractive.

**Contrasts in Mountain Scenery.**—Writing in Appalachia from the New Hampshire mountains of his visit to the Sierra Madre Mountains, Mr. Charles E. Fay begins by describing the contrast between the two scenes, than which, he says, there can hardly be a greater one. "The cool, balsamic air, the morning sky already piled with cumulus cloud prophetic of showers in mid-afternoon, the green fields cut by teeming brooks undulating away to meet the darker forest green that drapes the varied shapes of Whiteface, Passaconaway, Paugus, and the lower slopes of Chocorua, are a striking antithesis to what we looked on there. These mountains woo you, and there is an anticipated satisfaction in the promise made yourself to stand on every one of the peaks within your range of vision, attaining them by pleasant journeys through ferny, mossy, pathless woods. But in southern California the mountains do not invite one—at least, not for their own sakes. The conditions of climbing are most unfavorable. The summer heat is intense. They lie beyond an unattractive stretch; for the grass and flowers that in spring cover in wonderful profusion the ground that slopes upward to the sudden beginning of the steep foothills have withered, and in July all is parched and barren. The scattered live-oaks in the foreground, domineered by the will of the prevailing wind, have a half-frightened air; nothing of the repose of our maples, oaks, and white pines. The mountains themselves, rising with an almost monotonous uniformity of grade, are also burned as dry as a cinder, their dead-white rocks pallidly reflecting the remorseless sunlight. Not until near the summits or deep in the cañons do you find forest trees. The dull vegetation of the slopes of lesser altitude is of a shrubbery hard to penetrate, the most common sorts being a so-called greasewood (not the plant known in Colorado by that name) and a disagreeable thorn-bush, which, however slightly broken as you force your way through it, gives forth a sticky, milk-white juice; less frequent is the manzanita, its smooth, reddish brown being prettier to the eye than yielding to the push." These slopes abound in rattlesnakes, and there are myriads of lizards or "swifts."

**Amenities of Scientific Controversy.**—Says the Independent, April 20, 1893: "Not on the ground of incompetency, but on the ground of courtesy and decency, we will say that there ought to be a certain overhauling of the United States Geological Survey. Our attention has been called to articles in the American Anthropologist and the Literary Northwest by William J McGee, member of the Geological Survey, criticising a geological work recently written by a competent gentleman not connected with the Survey, but who has given great attention for many years to surface geology. This review is sprinkled with such words, applied to the author of this volume, as 'idlers,' 'pitiable paupers,' 'swindle,' 'harpies,' 'parasites,' 'shyster,' 'gull,' 'vulture,' and 'betinseled charlatan.' It is a long while since we have seen so indecent an article."

**The Channels of Mars.**—A new explanation of the channels of Mars is offered by Mr. T. W. Kingsmill, of Shanghai, China, as follows: As Mars revolves round the sun, under the rule of gravitation, it must have tides on its surface; and since its moons are not sufficiently large to cause any sensible rise, its tides must be mostly solar. Now, the best views we have of this planet are when it is in opposition—that is, when we are interposed between it and the sun, so that we should always see it best at high tide. The writer then makes rather a strong point of

the great eccentricity of the orbit of Mars, and the consequent heavy fall it makes when plunging toward the sun. Situated farther from the sun than we are, Mars must be regarded as an older member of our system; and since it is smaller than the earth, it is only natural that its surface crust should be thicker than that of our planet. Granting this, then the internal pulp would not have such a power to compensate for the rapid fall as the earth does internally, for there would not be so much of it, so that an external compensation, assuming the crust to be too thick to alter its form, would have to take place at the surface. On the surface, of course, the water is the only power; therefore we should expect, to put it in Mr. Kingsmill's own words, "that the water in the ocean would be projected into the Martial hemispheres, and as the planet approached the sun, tides would sweep round the planet; that the canals should sometimes appear and sometimes be duplicated . . . is only, *a priori*, what might be anticipated."

**Factors of a River's Character.**—Where a river shall go, what kind of a channel it will cut, how much work it will do, says A. P. Brigham, in his paper on Rivers and the Evolution of Geographic Forms, are matters determined, in an infinite number of ways, by the underlying strata. A river flowing on horizontally bedded rocks will tend to have, in its youth, a narrow cañon. Alternations of hard and soft strata give, in early stages of river life, alternations of rock benches and talus slopes; and many terrace-like horizons on the sides of the valley mantled commonly by soil, have this origin. Thus a terrace may be built up or carved out, and it may consist of alluvium, glacial rubbish, or bed rock. Tilted rocks give different types of river valleys in infinite variety. These types may be said to be just now beginning to attract a fair share of the interest of geographers and geologists. They will, in years to come, afford some of the most intricate as well as most fascinating problems which are open to inquiry.

**The Critical Point in a Thunderstorm.**—The belief that danger from lightning ceases as soon as the rain begins to fall heavily—expressed in the words of a mother reassuring her children, "Don't cry any more, God is sprinkling the earth with holy water"—prevails extensively among the Flemish peasants. Usually, according to M. P. J. De Ridder, lightning flashes from storm-clouds at the line between the heavy rain of large drops and the finer rain—or from the edge of the heavy rain. This is always the case in cumulo-nimbus storms, and as the number of storms of that kind exceeds all others, the belief of the peasants is at least worthy of attention. In nimbus storms, on the other hand, the critical point is at the latter end. In those of them which are developed in the veil of strato-cirrus, as when the sky is slowly covered, the rain falls at first without intensity and increases gradually, with distant thunder, while the storm itself does not seem to make much headway. But suddenly the rain falls more rapidly, and the dangerous moment has come. The roar of the thunder becomes terrible, the storm ceases, and the sky is cleared.

**The Agaves.**—The name of aloes is commonly given to plants of peculiar appearance which have long, fleshy leaves, with spines on their tips and sides; but this does not explain why the name has been given to species to which it does not belong, such as the agave, which do not resemble them. In Central America, their real country, where they have been cultivated on a large scale from the most remote times, they are called pitu, ozal, istle, metl, maguey, etc. Probably, soon after the discovery of America, a species of agave was introduced in the south of Europe, and became quite at home there. Linnæus, not realizing that all the agaves are American, gave it the specific name of *Agave americana*. Now there are more than a hundred species on horticulturists' catalogues, but many of these are only varieties. The uses to which these plants are found applicable are constantly increasing. In the United States and Europe they are only garden ornaments. In Mexico they hold the first place as wine plants and as textile plants. The filamentous substance obtained from their leaves is known all over the world as aloes fibers. These fibers, of length and thickness depending on the variety and locality, are so elastic and durable as to be in great demand for ropes, brushes, harness, and coarse woven

goods. The national drink of the country—its wine and cider, there called *pulque*—is produced from this plant. When pulque not yet wholly fermented—then called *agua miel* or maguey juice—is properly distilled, an alcoholic drink called *mescal* is obtained. The plants are cultivated on a large scale in the lower and middle lands of which the agave is native, and the consumption and exportation have attained a great development. The maguey enjoys the advantage of flourishing where nothing else can grow; and immense tracts of sterile soil on the seacoast have been, under the stimulus of profit, made to produce remunerative crops. Yet the plant does not reject fertilizers, and those containing potash have been found very good. The elevation and climates of the several provinces varying considerably, many kinds of agave are cultivated, according to their adaptations, and have been given as many local names, which are Aztec or Spanish. Some ten varieties are adapted to produce fibers of *henequen*, or Sisal hemp—long, silky, elastic, and durable fibers suitable for rope-making or for coarse woven fabrics. Other varieties called *lechuguilla* in Mexico, having shorter and coarser fibers, furnish acceptable substitutes for hog's bristles in brush-making. These fibers are called *istle* or *tampico*. The thick and fleshy part of the root of some of these agaves—called *amole*—is used for soap, and when roasted furnishes what is considered a "savory food." The *Agave americana* is planted in Algeria for hedges. The dry flower stalks furnish materials for light buildings; and the pliant pith is made into insect paste and dressing for razor strops.

**The Danger of the Celluloid Button.**—An instance is related in England in which a lady was put in great danger while standing before a bright but not blazing fire by the burning of one of the fancy celluloid buttons of her dress. Experiments made by Prof. C. Vernon Boys prove that articles composed of this material are very susceptible to heat and take fire very readily. Prof. Boys advises the public to guard themselves from what is likely to be a grave source of harm, even to the extent of fatal issues, by taking the precaution of submitting to a very simple test that resembling tortoiseshell, hairpins, combs, and other ornaments, and toys. On briskly rubbing the button on cloth a strong smell of camphor is evolved. If this ready test fails, a small portion may be ignited; it will burn energetically with a flaring noise, and the fumes of camphor given off can not be mistaken. If the article is composed of other material, the smell will probably bring to remembrance that produced on burning feathers. Celluloid, it is said, may be made uninflammable and safe by mixing with it certain metallic salts—among them the chloride of tin.

**Evolution of the Color of Birds.**—Mr. Charles A. Keeler, of the California Academy of Sciences, has published a volume of 336 pages on The Evolution of the Colors of North American Land Birds. In explanation of how he arrives at the theories which he advances he quotes the experiments and researches of many celebrated scientists on the evolution of the colors of butterflies, goldfish, spiders, etc., and dwells particularly on the effects of climate and the laws of heredity—uninterrupted transmission, sexual transmission, and mixed or mutual transmission—as the chief elements in the evolution of the coloring of birds' plumage. Remarking, *en passant*, that the plumage of birds, confined or diseased, loses its brilliancy, and that, should the confined wild bird breed, the plumage of the offspring would be of less beautiful colors than the parent, Mr. Keeler cites Mr. Darwin, who says: "Each of the endless variations which we see in the plumage of our fowls must have had some efficient cause; and if the same causes were to act uniformly during the long series of generations on many individuals, all probably would be modified in the same manner." And in relation to the fact that there is a general constancy of coloration in the wild birds, he remarks that this uniformity of coloration is preserved by free intercrossing, and where this is prevented by isolation or migration, variations of color very frequently take place. Young birds of various species, after the autumn molt, continue through the winter to assume, by degrees, the more intense colors characteristic of the adults, without changing feather; and Mr. Yarrell says that many birds appear to become more brilliant in color as the breeding season approaches, without either molting or the

wearing away of the tips of the feathers. Of the effect of food and environment upon the colors of bird plumage, Mr. Keeler believes that the direct influence of the environment plays an important part in the evolution of colors, and regarding food he quotes Mr. Frank Beddard, who says in Animal Coloration: "If the nature of animal colors is borne in mind, it seems impossible to doubt the modifying action of food; those that are due to structural peculiarities of the parts colored (e. g., feathers of many birds), may be altered just as much as those that are caused by the deposition of pigment; for the 'structural' colors depend largely upon pigment for their manifestation. . . . When there is an obvious relation between waste matter and the skin pigments, it can not be doubted that variation only in the amount of the food may lead to color changes." Some interesting color evolutions are given in the chapter entitled The Direct Influences of the Environment; for instance, if a yellow canary is fed with cayenne pepper, it will cause the feathers to turn red; carmine was given to some canaries and the yellow feathers became white; while Amazon parrots change from green to yellow when fed upon the fat of certain fishes. Notwithstanding the exhaustive manner in which Mr. Keeler has treated the subject, he says that "the paper is written more with the hope of stimulating thought, and inciting in a new and as yet almost untrodden field of ornithological inquiry, than with the expectation of reaching definite results."

**Behavior of Young Snakes.**—One of the most curious matters connected with the breeding habits of certain snakes is the "egg-tooth," a small tooth fixed to the united premaxillary bones, and projecting slightly forward, beyond the edge of the upper lip. It is present only in the embryo, and is shed very shortly after the escape of the young snake from the egg. This tooth is employed by the little snake in ripping open the tough egg-covering in its efforts to escape from its prison. The young of the *Heterodon* (a snake closely allied to the copperhead) are perhaps the most amusing youngsters of the snake family. In Volume XV of the United States National Museum, O. P. Hay, in a paper entitled On the Breeding Habits, Eggs, and Young of Certain Snakes, gives a very interesting account of the singular habits of the young *Heterodon* from personal observation. Having received a consignment of twenty-seven eggs, which were supposed to be those of the copperhead snake, he watched the bursting from the tough, parchment-like egg-covering of the young snakes, and exactly eight days after the receipt they were all hatched, the length varying from seven to eight inches. "From the moment of escape from the egg all were quite active and manifested the characteristics of the adults. . . . A faint hiss was uttered, but that may not have been voluntary. One would sometimes flatten its head and body and rear up with the anterior third of its length from the ground. If one did not know well their inoffensive natures, one would be excused for fearing to handle them. An exceedingly singular habit possessed by the adults (which is also practiced by the young) is that of feigning death." On being struck or teased, they will roll over as if in the intensest agony, and then throw themselves on the back and lie there as if dead. If left undisturbed for a little while they would turn over and creep slyly away. In this paper Mr. Hay treats the peculiar appearance of the eggs of snakes, which bring forth their young alive, very interestingly, and it would seem that even in these also there is present the singular egg-tooth.

**Precautions against the Lizard.**—A superstition prevails among the Shuswap Indians of British Columbia that a man who sees a small lizard of a particular species is followed by it wherever he may go during the day, till at length, when he is asleep during the following night, it finds him, and, entering his body, proceeds to tear out his heart, so that he quickly dies. The late Mr. Bennett, of Spallumsheen, told Dr. Dawson in 1877 that the Indians employed by him in making a ditch for purposes of irrigation, on coming into camp in the evening, would jump several times over the fire in order to lead the possibly pursuing lizard to enter the fire and be destroyed in attempting to cross. He also noticed that they carefully tied up the legs of their trousers when retiring. If, while at work during the day, they saw one of these little lizards, which appeared to

be abundant in that locality, it would be caught in a forked twig, the ends of which were then tied together with a wisp of grass, and the butt end of the twig afterward planted in the soil. Thus treated, the lizard soon died and became a natural mummy. If, during the progress of the work, any one found and carelessly tossed aside one of these lizards, the Indians would throw down their tools and search diligently until they found it and secured it in this manner. A similar belief to the one here recorded is noticed in Nature by Mr. C. Bushe, as prevailing in Ireland, with reference to water-newts, which are there called man-eaters. One woman to whom a specimen was shown, said they were known to jump down people's throats, to their certain destruction.

**Life in Morocco.**—The present population of Morocco, says Nature, is a puzzle almost as difficult, although on a smaller scale, as that of China. The authors, Lieutenant-Colonel Sir Lambert Playfair and Dr. Robert Brown, of the Bibliography of the country, give 4,000,000 as an estimate, but the guesses of various authorities vary between 1,500,000 and 15,000,000. The roads shown on the map are merely mule and camel tracks made by the feet of the pack animals, unaided by any engineer. Ferries are rare, and, of course, bridges are unknown in the interior. The distribution of towns and villages is often at variance with the rules holding for civilized countries. The villages are built out of the way of the main tracks, because people never travel in Morocco for the good of the inhabitants, and it is safer to live off the path of the tax collector and the government official, who demand free food and quarters. The great number of place-names on the map of so thinly peopled a country is due to the fact that the tombs of saints are such important landmarks that they must be indicated, even if only a few persons live beside them. All the places beginning with Sidi (Lord, Master) are either actually tombs, or the tomb has formed the nucleus of the town or village. "Sok," another affix of frequent occurrence, means market-place, and many of the established sites for periodical fairs are uninhabited between the gatherings of people from far and near. Many of the place-names on the coast exist in two forms at least—the native word and its Portuguese or Spanish translation; Casabianca and Dar-el-beida (both meaning white house), for example.

**Sirius and its Companion.**—The slight periodical displacements of Sirius, first observed about seventy years ago, were found by Bessell in 1851 to be due to its revolution in an ellipse, the largest diameter of which is 2·4″, which is accomplished in about fifty years. Sirius was therefore concluded to be a double star, with a satellite of considerable relative importance, which, as it was not seen, was supposed to be dark. The satellite, which is not quite dark, was seen for the first time in 1862; and can now, by taking proper precautions, be found at will. The period of revolution of the group has been determined by M. Auwers at forty-nine years and between four and five months, and the orbit an ellipse, the greater axis of which is 2·42″. Hence, according to the estimated distance of Sirius, the two stars are about twenty times as far apart as the distance of the earth from the sun, or equal to the distance of Uranus. The mass of the whole system has been computed to be 5·24 times that of the sun, of which Sirius has 2·20 times and the companion 1·04 time. The orbit of the companion is larger than that of Sirius. The distance apart of the two stars, now less than 4″, will diminish for two years longer, after which it will begin to increase again, till in twenty-six or twenty-seven years it will exceed 11″. The discovery of the system and of the rate of its revolutions affords proof of the operation of the force of gravity beyond the limits of the solar system.

**Origin of Cholera.**—All the theories of the origin of cholera, Mr. C. Egerton Fitzgerald suggests, may be right. The disease will eventually be found to be a miasmatic one, of which the hitherto undiscovered germ can be conveyed through the air, by water, excreta, infected bodies, and clothing. What the special germ may be we as yet know not; but that it multiplies with enormous rapidity under favorable conditions of heat, moisture, and dirt there can be no doubt. Each individual as he is attacked becomes a fresh nidus, a hotbed for disease germs, which seek and require only a suitable soil or cul-

tivating medium for their propagation; but a suitable condition of the atmosphere exists only under certain exceptional circumstances. This accounts for the rapid spread of cholera among large masses, especially dirty masses, of men. Each unit of infection acts on suitable media exactly as would a particle of yeast if introduced into a mass of fermentible fluid under the requisite conditions of temperature, etc. This is the explanation of the fact that, although cholera may arise sporadically anywhere, under favorable but exceptional circumstances, it is endemic only in India, where, presumably, these requisite conditions constantly prevail. That cholera does spread principally along the lines of human intercourse, that it may be conveyed by man, by water, by fomites, may be readily conceded without affecting the contention as to its miasmatic and aërial character and method of propagation. That cholera is caused by Koch's vibrio is to the last degree improbable, and certainly unproved, and the presence of that microbe in the dejecta of cholera patients may be due simply to its finding a congenial soil there.

**Progress in Practical Electricity.**—The recent inaugural address of Mr. W. H. Preece, as President of the English Institution of Electrical Engineers, was devoted to a review of the progress of the practical applications of electricity during the forty years of the speaker's service in developing them. He spoke first of the extension of the telegraph; then of the oceanic service of the Eastern Telegraph Company, the greatest cable corporation in the world, whose system of 25,370 miles stretched from Cornwall to Bombay, connected the northern and southern shores of the Mediterranean with Malta, and joined the various other islands of the Mediterranean and the Levant. This company, in conjunction with the Eastern Extension and the Eastern and South African Companies, also gained access to Australia and New Zealand on the one hand, and the Cape of Good Hope on the other, the combined mileage reaching a total of 47,151 miles. There was no more perfect apparatus in existence, the speaker said, than the lightning protector, and if it ever failed to do its duty it failed from man's neglect of some simple rule or his failure to keep it in proper order. In 1892 not an accident was recorded in any high-class telegraph instrument in the whole United Kingdom. To railways, electricity had proved an invaluable adjunct—in the repetition of signals obscured from the view of the signalman, and in night signals. The number of telephones in actual use might be put down at a million. The speaker had recently devised a new form of cable which would probably quadruple the rate of telegraphic cable working to America. There was no theoretical reason why we should not converse between London and every capital in Europe, while it was not impossible to speak even across the Atlantic. Heating and cooking apparatus worked by electricity had not at present a very favorable outlook, though many appliances had been shown in operation. The electric light was essentially the poor man's light. Many efforts were being made to utilize the waste forces of Nature in producing electric currents for the economical supply of the light. There were many towns whose streets could be brilliantly illuminated by the streams running past them. The range of power transmission had been enormously extended since much higher voltages than were possible with continuous currents could be employed. Meanwhile, power transmission by single-phase alternating current had also been developed. The use of electrically transmitted power in mines had been greatly extended within the last few years, especially in America, and the use of electrical energy for working railways was making gigantic progress in the United States, while it had begun to make a serious move in the United Kingdom.

## NOTES.

In his article in the April number of The Popular Science Monthly entitled Science and the Colleges, President D. S. Jordan made the statement that "it is not many years since the faculty of one of our State universities spent a whole afternoon discussing the proposition to abolish laboratory work in science." He now writes us that although the statement was given on what he regarded as good authority, he has been informed by a member of the faculty of the institution in question, who took part in the discussion, that the question was not whether laboratory work should be abolished, but simply whether, in the course leading to the degree of B. A., laboratory work should not

be made optional rather than obligatory. In other words, the movement was not in the direction of opposing laboratory work in science, but in the direction of the extension of the elective system. He therefore desires this correction to be made.

The entertainments called the Urania Spectacles that have been given in New York and Boston during the past two winters are very successful efforts to exhibit some of the wonders of science to large audiences. They consist of numerous photo-opticon views, in which coloring and motion as well as form are shown, accompanied by an explanatory lecture. The lecturer is Mr. Garrett P. Serviss, whose ability to make the facts of astronomy interesting is well known to the readers of the Monthly. The spectacles are now three in number: A Trip to the Moon, The Seven Ages of our World, and The Wonders of America. Among the more striking pictures in the first of these are an eclipse of the sun, close views of lunar craters and cañons, and the rotating earth as it would be seen from the moon. In the second the progress of a world from a nebula to a burned-out cinder is traced; and in the last the marvelous scenery of our own land is depicted.

A specimen of volcanic dust from near Omaha, Nebraska, is described by Prof. J. E. Todd. It was from a stratum of whitish aspect, about eighteen inches in thickness, found in the bluffs facing the Missouri River. It has the same general characteristics as the volcanic dust which has been found in quantity along the Republican River, in southern Nebraska, and in Knox, Cumming, and Seward Counties in the same State; but it differs in being stained with oxide of iron and the sharp angular grains coated with carbonate of lime. This locality is the most eastern exposure of the volcanic dust stratum which is found scattered over the most of Nebraska.

The summer school has now been made an integral part of the university at Cornell, and will be open for 1893 with courses considerably enlarged in scope. Without excluding others qualified to take up the work, these courses are offered for the special benefit of teachers. They are open to women as well as to men, and the same facilities for work are afforded to those students as to the regular students of the university. Every opportunity will also be afforded for original research. Addresses will be delivered similar to those given in 1892 by President Schurmann and ex-President White. The session will continue from July 6th till August 16th.

The sixth session of the Marine Biological Laboratory, Woods Holl, Massachusetts, will begin June 1st and continue till August 30th. The Laboratory for Investigators will be open during the whole time, and in it twenty special tables will be provided for those who are prepared to begin original work. An elementary course in vertebrate embryology will be introduced, with studies mainly of the fish-egg, conducted by Mr. Lillie and Prof. Whitman, to open July 5th and continue six weeks. The Zoölogical Laboratory for Teachers and Students will be open during the same time, with regular courses in zoölogy and microscopical technique, in which students will be permitted, under special conditions, to begin their individual work as early as June 15th. The Botanical Laboratory will be opened July 5th for study of the structure and development of types of the various orders of cryptogamic plants, giving special attention to the marine algæ. A department of laboratory supply has been established, to fill orders from a distance, in which a considerable number of species are kept in stock. The laboratory is under the general direction of Prof. C. O. Whitman, with whom are eleven professors in special branches, and other assistants.

The opinion expressed by Mr. Alfred G. Mayer, in his article on the Habits of the Garter Snake, published in the Monthly for February, that snakes, as feeders on frogs and toads, are therefore friends of insects and indirectly enemies of leaves, is criticised by Garden and Forest as a dangerous generalization, "for, although the snakes will eat frogs and toads, as well as anything else in the line of small animals that they can master, they also eat a great many insects, and they could not, under any circumstances, in justice, be called protectors of insects."

The valuable memoirs of T. A. Conrad on the Tertiary fossils of the United States have become very rare, and are practically out of the market. Yet the work is of great importance to students. The idea of reprinting the work has accordingly found favor. A reprint of the volume on the Eocene is contemplated by Mr. Gilbert D. Harris, of the Smithsonian Institution; and the Wagner Free Institute of Science, of Philadelphia, proposes to reprint the volume on the Miocene—the Medial Tertiary—with photogravure reproductions of the original plates and an introductory chapter and a table showing the present state of the nomenclature of the species; the whole forming an octavo volume of about 150 pages, with 49 plates. Subscriptions are asked for 150 copies, at \$3.50 each.

Mr. Joseph E. Carne, Curator of the Mining and Geological Museum at Sydney, Australia, has been appointed a geological surveyor.

Researches into the conditions of the life of micro-organisms have shown them to be variously adapted to considerable diversities of temperature, and some of them to be adapted to great ranges. Forster and Bleekrode have found a few species containing

immense numbers of individuals, and living in various media, capable of developing at the freezing point. One of them, a sea-water species, produces phosphorescence at that temperature. It is well known that to preserve meat and other articles of food successfully it is necessary to employ a much lower temperature than that of the melting of ice, and experience has further shown that this is best done when the atmosphere is deprived of moisture.

Electric currents were proved many years ago to exist in plants; and Kunkel was led to think, by his experiments, that they were caused by the mechanical process of water-motion, set up on application of the moist electrode. A new investigation of the subject has been made by Herr Haaske, and he concludes that it is unquestionable that changes of matter of various kinds are concerned in the production of the electric currents, especially oxygen-respiration and carbonic-acid assimilation; and that while water movements may possibly share in their production, their share is certainly only a small one.

Mr. Kedamath Basu has observed that under the influence of enlarged education and refinement, tattooing and the use of red paint on the forehead and crown are diminishing among the women of Bengal. These fashions still persist in the Northwest Provinces, along with the insertion of thick and heavy wooden plugs in the lower lobes of their ears.

A specimen of ruthenium, weighing two kilogrammes, prepared by M. Joly, was recently exhibited in the French Academy of Sciences. The metal is very hard and brittle, having a specific gravity of 12, and melts at the temperature of the electric arc. It is usually found associated with iridium, palladium, rhodium, and osmium, in platinum ores.

Herr Du Bois-Reymond has shown, in a communication to the Physiological Society of Berlin, that a sensation of heat follows the immersion of the hand in a receiver containing gaseous carbonic acid. A like effect is produced by other gases which do not enter into the composition of the air. The heat sensation may be compared with that produced by a temperature of 68° Fahr. in the air. The phenomenon results from a stimulation of the nerves sensitive to heat.

Experiments are described by Herr Wesendonck, the object of which was to determine whether electrification is produced by the friction of gases. While ordinary air gave considerable charges, negative or positive, according to the adjustment of the apparatus, no electrification was produced when the air had been previously freed from dust and moisture. Oxygen behaved in the same way. Carbonic acid, evaporated from the liquid state, imparted a strong positive charge, which was, however, reversed as soon as the cold led to the precipitation of watery vapor. Ordinary atmospheric dust was found to electrify the brass negatively, and the charge was increased by previous drying. It seems, therefore, that pure gases are incapable of producing electrification by friction, and that the effects observed are conditioned by the presence of solid or liquid particles.

An account of a thunderstorm in which the rain was mixed with live land mussels, which is said to have occurred at Paderborn, Germany, in August, 1892, is published in Das Wetter. A yellowish cloud attracted the attention of several people, both from its color and the rapidity of its motion, when suddenly it burst. A torrential rain fell with a rattling sound, and immediately afterward the pavement was found to be covered with hundreds of the mussels.

Dr. E. Lewis Sturtevant has presented to the Missouri Botanic Garden, St. Louis, his entire botanical library, which is particularly rich in pre-Linnæan works.

The question of evaporation from the surface of snow is discussed in a Russian meteorological journal by M. A. Müller, of the Observatory of Ekaterinberg. Authors who have prexiously written on this subject, including Nuckner, Woeikoff, and others, have not been agreed as to whether the evaporation exceeds the condensation from the air in contact with the snow. The method usually adopted has been to compare the temperature at the surface of the snow with the dew point, and assume that if it is superior, evaporation, if inferior, condensation, takes place. M. Müller's observations were made from December 21, 1890, to February 28, 1891. His conclusion is that, according to the method adopted, evaporation is superior to condensation in the proportion of 73 to 27.

The report of a parliamentary committee on the plague of voles in Scotland shows, on the authority of early Celtic chroniclers, that as early as the year 895 Ireland was devastated by a plague of "vermin of a mole-like form, each having two teeth," which "fell down from heaven," and were driven out only "by prayer and fasting." There is also a plague of voles in Thessaly (a Grecian land), and the Mohammedans there have sent to Mecca for some holy water.

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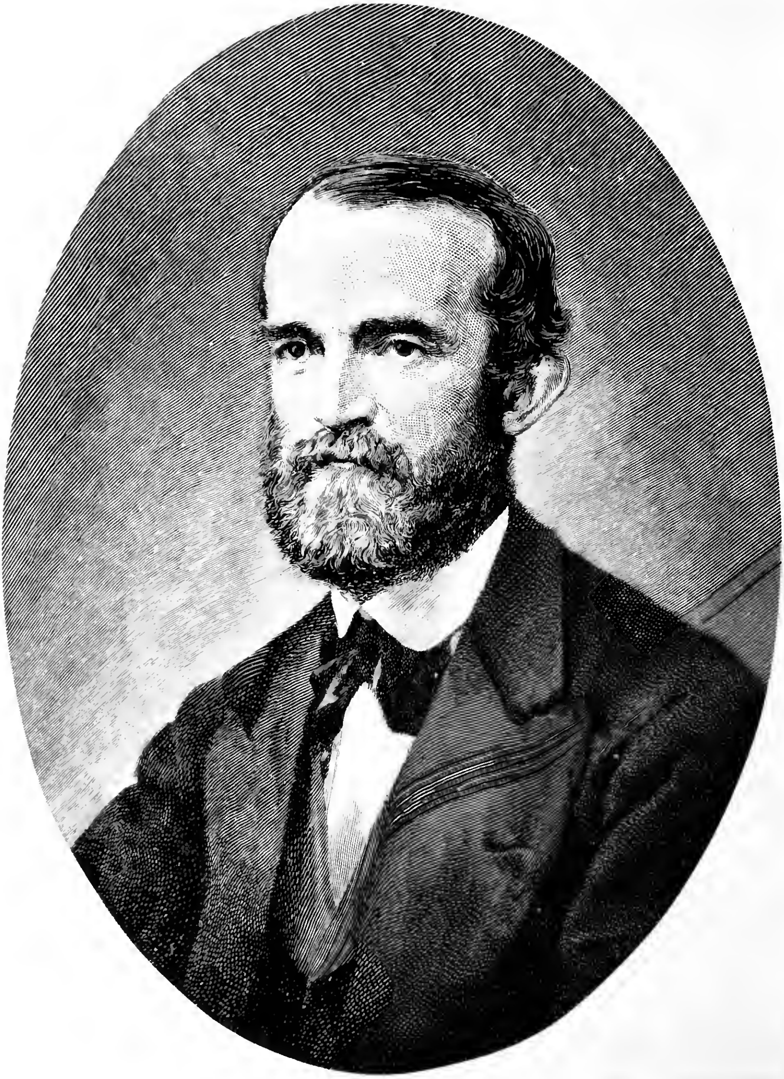
## OBITUARY NOTE.

The Rev. F. O. Morris, of Yorkshire, England, a well-known popular writer on natural history, died April 10th, aged eighty-two years. Among his many books were A History of British Birds, in six volumes, and Natural History of the Nests and Eggs of British Birds.



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# THE SPANISH INQUISITION AS AN ALIENIST.

By HENRY CHARLES LEA.

THE degree of responsibility attaching to insane criminals has in all ages been a difficult problem for the dispenser of justice. I am not aware that the contributions made to its elucidation by the Spanish Inquisition have ever received attention, and the history of a few cases which throw light upon this phase of the subject may not be without interest.*

On September 20, 1621, Madrid was startled by the report of a shocking sacrilege committed in the chapel of the archiepiscopal prison. A vagrant Catalan, named Benito Ferrer, had been arrested as an impostor for begging in clerical garments without being in orders. The offense was not serious, and after a month's detention he was about to be discharged, when, at the morning mass, as the bell tinkled to announce the elevation of the Host, Benito, who was praying with a rosary in an upper chamber, rushed down like a madman to the chapel, seized the Host, which had been deposited on the communion cloth, broke it, flung the fragments on the floor and trampled on them, exclaiming, "O traitor God of darkness, now you shall pay me!" He was promptly seized and carried to the courtyard, where he was stripped of his cassock, and when some fragments which had lodged in it fell to the ground he endeavored to stamp on them with similar ejaculations. The first care of those present was to gather reverently the pieces of the body of the Lord; the soles of Benito's shoes were carefully scraped, and the dust and sand

* I am indebted to the custodians of the Königliche Bibliothek of the University of Halle for the opportunity of consulting the records of these cases.

of the courtyard were swept up into a white cloth. He was chained hand and foot, maintaining a sullen silence and refusing to answer questions.

The affair, of course, excited the utmost horror. The young king, Philip IV, then only five months on the throne, sent his favorite, Count Olivares, to ascertain for him the facts, and the papal nuncio eagerly sought the details to report them to Rome. The archiepiscopal vicar, Diego Vela, was at first disposed to take a rationalistic view of the matter: he asserted the insanity of his prisoner, and proposed to discharge him, doubtless thinking it wiser to assume that no Spaniard in his senses could be capable of an offence so heinous. He was soon, however, made to understand that this would not be allowed, and it came near bringing him into trouble. The Holy Office asserted its jurisdiction over a case of heresy so flagrant; on the 23d Vela surrendered Benito to the Supreme Council of the Inquisition, and he was sent to the tribunal of Toledo (for as yet there was none in Madrid), with orders that his trial should be pushed with all expedition—an urgency that was soon after twice repeated, with the significant addition that the king took special interest in the matter and desired to know its progress.

The Toledan inquisitors were prompt and zealous. The dilatory and cumbersome forms of procedure were hurried as rapidly as the traditions of the tribunal would permit, and in exactly two months, on November 23d, they were ready to pronounce sentence. Yet the end was still far off. In his examinations Benito had been made to give the details of his life. He was forty-three years old, born at Camprodon of an Old Christian father and a mother who had Jewish blood in her veins—a fact which told heavily against him. His father, who was a cloth-shearer, took him, at the age of thirteen, to Montserrat and placed him with an uncle, a chaplain in the monastery, who in six months sent him back to his father in Barcelona. For some time he served as page to persons of quality, and finally Don Bernardo Terres took him to Flanders, when the Cardinal Archduke, Albert of Austria, went thither in 1595. There he had a succession of masters, with one of whom he returned through France to Catalonia. Filled with desire for a religious life, in 1603 he entered the Barefooted Carmelite convent of Mataron as a novice, but was expelled in about six months. After vainly seeking to join the Carthusians of Monte Alegre and the Jeronymites of Murta, at last the Observantine Franciscans of Barcelona gave him the habit, but deprived him of it in about eight months. Then two years were spent in study at Tarragona, which he left in 1606, and since then he had led a wandering life in pious pilgrimages. He had offered his devotions at the shrine of his

namesake, San Vicente Ferrer, at Vannes; twice he had been to Rome and once to Monte Cassino and Sicily, besides traversing Spain and Portugal in all directions. About 1609 came the shadow which darkened his subsequent life. Fray Francisco de la Virgen, the master of the novices at Mataron, was Antichrist, and had bewitched him, since when all men whom he met were demons. He had ceased to attend mass or to confess and take communion, for he could find no priest who was not a demon. When, in the upper room of the prison, he was praying and heard the bell that told of the elevation of the Host, it was revealed to him that the officiating priest was a demon and the Host was another. In doing what he did he performed a service to God, and he would repeat it fifty millions of times if the occasion required. This Carmelite Antichrist, moreover, had in 1606 killed Philip III and his three children, and their places had since then been filled by demons. There was also some wild talk about Toledo being no longer Toledo, nor Madrid Madrid, for Saint Joseph had changed them all. Barcelona is now La Imperial de Santa Ana, and is on the Straits of Gibraltar, for Catalonia has grown so that it is now larger than all Spain was formerly. The emperor of La Imperial is Don Dalman de Queralt, who daily sends him food in prison, so that he has not to accept it from the demon alcaide and his attendants. The inquisitors have no power to burn him, for they are all demons and he is in the hands of God. With all this he was strictly orthodox in his replies to the searching questions of the inquisitors as to his belief in transubstantiation and other points, except that he attributed five persons to the Godhead—Michael and Gabriel being added to the Trinity. Throughout the course of his prolonged trial nothing could make him swerve from these hallucinations or modify his story. He defied the inquisitors, for he had a revelation in prison that they were demons and had no power to harm him.

Anxious as were the inquisitors to push the trial to a conclusion, they felt that evidence of his sanity was necessary. For this they examined the alcaide of the prison and his assistant and three fellow-prisoners confined in the same cell. All testified to Benito's soundness of mind as evinced in his daily actions, though he was silent and reserved and spent most of his time in prayer or in reading his breviary. Then three physicians were made to visit him several times, who reported that he talked sanely on most subjects but wildly on others; the insanity seemed feigned, and according to the rules of the medical art he was sane. Thus fortified, on November 23d, the inquisitors called together the regular *consulta*, an assembly of experts, to decide on the case. There were nine of them in all—the three inquisitors, the Vicar General as representative of the Archbishop of Toledo, and five

*consultores* or assessors. Opinions were not harmonious. Four voted to put Benito to the torture to verify his sanity, and if this failed then to make inquiry into his antecedents, Three voted to relax him to the secular arm for burning, first employing learned theologians to convince him of his heresy. Two were in favor of the common-sense plan of endeavoring to ascertain his sanity without torturing him.

When, in the customary routine, these diverse views were submitted to the Inquisitor General and Supreme Council, that body considered the case maturely. Statements of the leading points involved were laid before three skilled theologians, two of whom pronounced Benito to be a sacrilegious heretic whose delusions were feigned. The third opined that he might be subject to demoniacal possession, for which he should be exorcised and subsequently tortured to ascertain the truth. On January 12, 1622, the Council sent these *calificaciones* or opinions to Toledo, with instructions to get similar ones from learned men there; also, to examine more carefully into Benito's sanity and to investigate the causes of his expulsion from the convents which he had sought to enter. Accordingly, on January 15th, the Toledo tribunal assembled four Dominican masters of theology, who unanimously pronounced Benito a heretic and an impostor. To ascertain details about an insignificant novice who some twenty years before had passed a few months in a convent might seem impossible, but the perfected organization of the Inquisition was equal to it. The tribunals of Barcelona and Valencia were called upon; the *frailes* who had been novices in Benito's time were hunted up in the convents to which they had scattered, and four were found who entertained some recollection of him. Three of these described him as mentally deficient, and one of these remembered his having revelations; the fourth spoke of him as "melancholy" and like one possessed by the devil.

May was drawing to an end when the result of these investigations reached Toledo, and the summer was spent in fresh examinations of those in the prison who had access to Benito, and in getting opinions from theologians and physicians. That he showed signs of insanity was evident, but the experts held that the proof of soundness of mind was infallible and the madness feigned. So when, on September 10th, another *consulta* was held, the vote to burn him was unanimous—the two assessors who had previously advocated simple investigation having been discreetly omitted from the meeting. On this decision being submitted to the Supreme Council, it met with no greater acceptance than the former one, and it was sent back September 17th, with orders to torture Benito to ascertain his intention in the sacrilege and the fiction of his insanity.

In the proceedings of the Inquisition torture was so universal a resource in cases of doubt, that its use for the diagnosis of insanity need not be a matter of surprise. On October 13th it was duly applied. Benito was brought in and told that if he would not confess the truth he would be tortured, to which he replied quietly and earnestly that he had told the truth and was not mad; he had acted only as a faithful Christian and at the command of the Eternal Father. In the administration of torture the nerve of the patient was tested at every step with adjurations to tell the truth and with promises of mercy—lying promises, for confession would only secure the boon of being garroted before burning. So in this case, at the making out of the sentence of torture, its formal signing, the adjournment to the torture chamber, the stripping of the prisoner, the tying him to the *banquillo* or trestle, the adjusting of the *cordeles* or sharp cords around each thigh and each upper arm—at every stage he was entreated affectionately (*con mucho amor*) to tell the truth and save his soul. Benito's resolution was immovable; to every adjuration his reply was the same—he had told the truth, and the inquisitors were demons. Then the torture began, scientifically graduated, and at every interval came the adjuration and the response. First a single cord around each member, successively tightened and twisted into the flesh, then another and another, until there were six on each limb and the blood was dripping from them all—in spite of the universal rule that torture was never to be carried so far as to cause effusion of blood. The official report of the examination minutely records his shrieks and groans and writhings, his fruitless prayer for water, his despairing appeals to Jesus, Mary, and Joseph, his cries that he is dying, and through it all his unvarying response that he had told the truth and that the inquisitors were demons—an assertion which he once offered to prove if they would give him a Bible. When the capacity of the *cordeles* to inflict increased torment was exhausted he was threatened with the rack, but to no purpose. It was made ready and he was stretched on it, but this augmentation of agony was fruitless. His resolution was unconquerable, and at last his wearied judges ordered him to be untied, still threatening him with a continuation of the infliction if he would not tell the truth. Exhausted nature could do no more; with a final ejaculation that he had told the truth, for they were demons, he sank motionless and remained silent.

For three unbroken hours the torture had lasted, and the inquisitors said that it was too late for more that day, so they suspended it, warning him that they were not satisfied, and that it would be resumed if he did not tell the truth. He was carried back to his cell, and two days later was brought before the tribunal again. Even in the pitiless secular criminal legislation of the

period the endurance of torture without confession was held to purge away the evidence against the accused and to entitle him to an acquittal, but it was otherwise in the Inquisition. The torture had been merely to gratify the curiosity of the judges and to justify the foregone conclusion of his burning. Therefore, when they now examined him and adjured him to tell the truth, and he answered by referring to his previous statements as the truth, they had him carried back to his cell, and coolly assembled their *consultores* to pronounce on him a second sentence of relaxation to the secular arm for burning. This was duly submitted to the Supreme Council, which postponed its answer until November 24th. Then it said that it held him to be insufficiently tortured, but that for the present he should be kept in prison and carefully watched to determine his sanity. He was to be confined with persons who could be relied upon and sworn to secrecy, who should observe him and report.

Another cell was accordingly selected for him, in which were two friars and a physician awaiting trial, who were duly sworn and instructed. So matters continued for a year, with occasional examinations of his fellow-prisoners. The friars pronounced him a heretic and an impostor; the physician a sane man subject to delusions. Finally, in November, 1623, another consultation was held to vote upon his case, and he was unanimously sentenced to burning. To this at last the Supreme Council assented, but desired the execution to take place in Madrid, where the sacrilege had been committed. He was to be sedulously kept in ignorance, and to be secretly conveyed to the capital. There, on the *Plaza Mayor*, January 21, 1624, there was a solemn *auto da fé* celebrated, and he was burned alive as an *impenitente negativo*.

If this was expected to strike salutary terror into the hearts of sacrilegious heretics and to instill respect for the Venerable Sacrament, it signally failed of its purpose. In less than six months, on Friday, July 5, 1624, Madrid was again thrown into excitement by a double sacrilege that had every appearance of organized premeditation. During the celebration of morning mass in the church of San Felipe, a man named René Perrault, who was kneeling near the altar, suddenly leaped forward at the elevation of the Host, and crying out, "Why do you elevate this idol of Christ, so that the people commit idolatry and offend God?" he snatched it from the hand of the priest and scattered it in fragments on the floor, while with a sweep of his arm he overturned the cup that was standing on the altar. At the same moment a similar scene was enacted at the church of Santa Barbara, by a man named Gabriel de Guevara. It was with difficulty that the offenders were rescued from the summary venge-

ance of the worshipers, and they were forthwith brought before the Inquisitor General, Andrés Pacheco. Apparently his experience of the Toledo Inquisition in the previous affair had not been satisfactory, for he at once himself undertook the preliminaries of the case, and hastily organized for its trial in Madrid a tribunal which sat in extemporized quarters in the convent of the Barefooted Carmelites. The documents concerning Guevara are not accessible, but those of the trial of Perrault present to us another aspect of the dealings of the Inquisition with insanity.

Friday was busily occupied with the examination of witnesses, and at 10 P. M. Perrault was brought before the inquisitor. He was still defiant, and told his story without hesitation or concealment. He was about forty years old, born at Angers, of Catholic parents. Brought up in strict orthodoxy, he had, until within a fortnight, always been a good Catholic, regular in his attendance on confession, communion, and mass. For twelve years he had wandered around Spain as a peddler of needles, thimbles, and such small wares, till a fortnight before at Talavera, while in the street seeking customers, a sudden revelation from God showed him that there was only one God, the Creator; that Christ was an impostor, who had properly expiated on the cross the blasphemy of calling himself the Son of God, and that what the people adored was idolatry and an offence to the Almighty. From that time this idea was ever present to him, on the road and in the house. God impelled him to do what he had done, and to come to Madrid for the purpose, so that the act should be more conspicuous. He had left his saddle-bags at Getafé, a village a few leagues distant, on Tuesday, July 2d, and had come with his mule to Madrid. There he first looked up a French paper and fruit seller named Domingo Diaz, of whom he inquired the address of his brother, Pierre Perrault, an embroiderer living in Madrid. He found him, and told him of the revelation and his consequent intention, when Pierre earnestly reasoned with him, telling him that it was a suggestion of the devil, and that he would denounce him to the Inquisition if he were not his brother. The next morning Pierre came to him with an Italian, a tailor; they bought some food, crossed the bridge of Toledo, breakfasted by the roadside, and René agreed to return to Getafé. After parting he traveled half a league on his mule; he chanced to overtake a man going thither, by whom he sent word to his host to forward his saddle-bags to Madrid, and he turned back to the city. To render his act more symbolical, he resolved to postpone it until Friday, so he had a day and a half on his hands. These he spent in seeing the sights of the capital, and he mentioned his disappointment on going to the theatre and finding there was no performance. On Friday morning, at breakfast, he abstained from his customary

flask of wine, in order that it might not be said that he was drunk. He went to San Felipe and committed the sacrilege.

The next day, when brought again before the tribunal, his enthusiasm had evaporated. Excitement had been followed by reaction; he realized the terrible fate in store for him, and was eager to avert it in any way he could. He had been drunk, he said, the day before, and had stumbled against the priest; he was crazy; people had given him food which rendered him insane, and the ill-treatment to which he had been exposed habitually on the road had driven him mad. At Consuegra he had been beaten; at Medellin, beaten, imprisoned, and his goods confiscated; he was a good Catholic, and believed all that the Church believed, and he remembered nothing of the confession of yesterday; or, if he had said such things, he must have been out of his senses. When, later in the day, his formal defense was drawn up and presented by his advocate, it was that he had been drunk, and he now supplicated mercy and penance.

Probably no trial before the Inquisition, since the abounding harvest of its early days, was ever conducted so speedily. Though all the formalities were observed, on Sunday, July 7th, the consultation was held to determine the sentence. The opinion was unanimous that he should be relaxed to the secular arm for burning, but on the question of preliminary torture a difference arose. The Inquisition was naturally desirous to know whether he had accomplices; the simultaneous crime of Gabriel de Guevara pointed to concerted action; besides, one of the witnesses had testified that René entered San Felipe with two men clad in the French fashion, who departed at the commencement of the mass. René had consistently denied this, asserting his independence of action and sole responsibility; but heretic plots were always floating before the inquisitorial imagination, and it was manifestly impolitic to burn René without utilizing him for the conviction of his possible confederates. While, therefore, all the consulters agreed that he should be subjected to unlimited torture, some held that it should be *in caput alienum*, to discover his associates; while others, in view of his varying confessions, humanely urged that it should be employed for the benefit of his soul, and to confirm him in the faith. The next day the Supreme Council, in approving the sentence, decided that the torture should be *in caput alienum*.

At ten o'clock that night René was brought before his judges and questioned as to accomplices, but he only repeated his story, with a few additional details. In the torture which followed he manifested a curious mingling of strength and weakness. Before it commenced he flung himself on his knees and begged piteously for mercy, but refused to forfeit his soul by perjury, for he had

no associates, and no Frenchmen entered San Felipe with him. During all the stages of graduated torment he screamed and struggled desperately, but he adhered resolutely to this, and refused to incriminate any one; he had never breathed his intention to any save his brother, who threatened to denounce him to the Inquisition. This continued till half past one o'clock, when the inquisitors, finding the torture fruitless, announced its discontinuance; but next morning they commenced proceedings against Pierre Perrault and Domingo Diaz. What was the result of these we do not know; but had anything been extracted from them further compromising René, it would have appeared in the records of his trial.

If the torture thus was useless *in caput alienum*, it at all events served the more humane purpose of confirming the sufferer in the faith. On July 12th word was brought to the inquisitor Chacon that René desired to return to the Church: he hastened to the temporary prison where the culprit was confined and found this to be the case. Now that he had nothing further to hope, René said that his first statement was true. He had been misled and tempted by Satan for fifteen days before the crime, and had believed that he was rendering a service to God; but now God had enlightened him, and he reverted to his former belief in the Trinity, in the passion of Christ, and the transubstantiation of the sacrament, and he desired to be reconciled to the Church.

On the following Sunday, July 14th, Madrid enjoyed the religious spectacle of an *auto da fé*, in which René Perrault was burned, but doubtless his recantation obtained for him the privilege of being garroted before the pile was lighted. Thus, if Spain furnished to Geneva the Unitarian Miguel Servet, France returned the favor with René Perrault.

Another case, less tragic in its issue, illustrates a different phase of the subject. At Cobeña, a village not far from Alcalá de Henares, a poor carpenter of plows named Benito Peñas, or de Valdepeñas, created scandal by denying that Christ had died on the cross. He was wholly illiterate but devout, and once, when visiting Madrid with a load of corn, he had heard in the church of San Felipe a sermon by a *fraile*, who spoke of the passion and resurrection as metaphorical.* The idea took possession of his

* The Spanish preachers of the period allowed themselves the largest license in the effort to attract attention, and shrank from no grotesqueness of irreverence. In the trial in 1592, of Fray Joseph de Sigüenza, a distinguished Jeronymite friar and favorite of Philip II, there is a description of a sermon preached before the king by Fray Cristóbal de Lafra, another Jeronymite, on the feast of the Nativity of the Virgin. He said the Minotaur was Christ and the Labyrinth the gospel *liber generationis;* Ariadne was Our Lady, and the child she bore to Theseus was Faith; and that if any one desired to enter the Labyrinth

brain and played havoc with the anthropomorphic conceptions of orthodox theology, including the humanity of Christ. This had been going on for several years, when early in 1640 the attention of the archiepiscopal visitor, Bernardo Garcia de San Pedro, was called to it on his reaching Cobeña. He promptly threw Benito into the village jail, where many priests and friars visited him and labored fruitlessly to convince him of his error. Then, in July, Dr. Buendia, the physician of Cobeña, denounced him to the nearest commissioner of the Inquisition, Juan Burgalez Diaz, at Fuente el Saz. The affair was now fully in train. Diaz hastened to Cobeña, took testimony of some of the chief inhabitants, and forwarded the papers to the tribunal of Toledo. The inquisitors submitted to *calificadores* the propositions contained in the reports of Benito's talk, and they were duly condemned as heretical and Manichæan. The Inquisition, however, appears to have thought little of the matter, and it would probably have gone no further, had not a zealous cleric of Cobeña, toward the end of the year, written that the people were scandalized at the delay in acting in an affair so notorious. Thus stimulated, on January 25, 1641, the inquisitors issued an order to bring Benito to Toledo, and to sequestrate his property—the latter being the customary precaution for the event of a sentence of confiscation.

It was the invariable practice of the Inquisition, whenever possible, to make the accused, whether innocent or guilty, pay all the expenses attending his trial. The familiar to whom the order was sent was therefore required, in sequestrating Benito's property and placing it in the hands of a receiver, to keep thirty ducats for expenses; if there was no money or grain, then he was to sell at auction enough to realize this amount, and he was also to reserve a bed and bring it with him for Benito's use in prison. These customary instructions were rigidly carried out as far as practicable. A reversionary interest in some money left by a dead brother was garnisheed, and security taken to await the result of the trial. The only ready money in Benito's possession amounted to nineteen copper coins or *cuartos*, worth in all about two reales and a half; so on Sunday, February 10th, his pitiful store of furniture, tools, and clothing was sold by auction in the public square after high mass, reserving only the garments on his back and one of two old shirts for him to wear; even the rosary in his hands

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he must pray to the Virgin for her child. He also said that God was the heifer Io, who converted Jews; that wherever God trod he left his footprints, which are his works; asking who made these admirable works of the sun, the moon, etc., the answer, Yo Yo, gave the name, which is God—the name impressed by the steps of the heifer. It is therefore by no means improbable that Benito Peñas may have heard a sermon which conveyed to him the impression he described and led to his misfortunes.

was taken and sold. The total proceeds amounted only to two hundred and forty and a half reales, or less than twenty-two ducats, and, after deducting costs, the commissioner handed over to the familiar twenty ducats. The expenses of guards and the journey to Toledo consumed more than half of this; and when Benito was delivered on February 16th at the *carceles secretas*, there were but one hundred and five and a half reales left, which were duly entered on the prison books. The timid suggestion of the familiar of some remuneration for his time was left unnoticed.

When on February 18th Benito was examined, he willingly repeated all the articles of the creed except "suffered under Pontius Pilate, was crucified, dead, and buried, and on the third day arose from the dead," which he obstinately refused to utter. It was easy to entangle him in a theological discussion in which he was led to deny the incarnation and conception by virtue of the Holy Ghost, the birth and death, and the second advent. The efforts made to convince him of his error of course only hardened him in his belief, and he resolutely accepted the inferences drawn from it until he came virtually to deny the Trinity—the three names were but three different designations for the one God. He was ready, he declared, to die in defense of his belief, and all the theologians in France and Spain could not convert him. When the counsel assigned to him by the Inquisition found him immovable, he formally withdrew from the defense in order not to incur the penalties decreed against advocates who undertook to defend heretics.

In March the inquisitors began to entertain doubts as to Benito's sanity, and sent to Cobeña to obtain testimony respecting it. The evidence was emphatic as to his soundness of mind. The *cura* had known him for forty years, and had never entertained a doubt of it; the alcalde and others who knew him said the same. It was true that for a year or more prior to his arrest he had grown very devout, praying much and frequenting the church; moreover, on one occasion he had remained shut up in his house for some days, until the alcalde and *cura* broke in and found him lying with a rosary in his hand in a trance, from which they aroused him with a rope's end, and he had repeated this in a hermitage near the town, but in all the relations of life he had shown himself in full posession of his faculties.

Thus the case went on with the deliberation customary in the Inquisition, until in July it was resolved to make a more thorough investigation as to his sanity. Two learned theologians were deputed to examine him, who reported him to be crazy: his answers bore no relation to the questions put to him; he talked of the omnipotent God and the sweet name of Jesus; the Virgin was created without father and mother, and was anterior to Eve; when

we die our bodies are not converted into dust; in fine, he was not a case for the Inquisition, but for a madhouse. Then two more theologians were called in, and their opinions were the same. Evidently under the paternal care of the Inquisition his insanity was developing rapidly.

In August the three physicians of the Holy Office were summoned to examine him. Two of them questioned and cross-questioned him, and were prepared to pronounce him sane when the third arrived, and in the course of examination chanced to ask him what signs he had of his own salvation, to which he replied that when he commended himself to God he saw lights like stars descend from heaven to him. This convinced them, and they reported that he was insane or was subject to diabolic illusions. The alcaide of the prison and his assistant were then interrogated: they had no doubt of his insanity from his disordered talk and from the fact that they always found him kneeling in prayer. Then as a last effort two more distinguished theologians were deputed to convince him of his errors, but they found their labors hopeless, and declared that he was crazy.

It was impossible to resist this cumulative evidence, and when, on August 29th, the customary consultation was held to decide upon his fate, the opinion was unanimous that he was irresponsible. It was agreed to write to the authorities of Cobeña to that effect; his relatives must send for him and take care of him; he was never to be allowed to leave the town, and must henceforth wear a doublet half gray and half green. To this the response was that he had no kindred, but Juan de San Pedro was sent to bring him home, while a plaintive allusion to the expense of the journey and the absence of all property from which to defray it received no attention.

Thus the poor wretch was beggared, deprived of all means of livelihood, and condemned to the disgrace of exhibiting his shame in a party-colored garment at a time when such insignia had a peculiarly sinister significance. According to the convictions of the period, it was all for the greater glory of God; but as an alienist, the Inquisition was clearly not a success.

In his ascent of Mount Dulit in Borneo, 5,090 feet high, Mr. Charles Hose found a cave above four thousand feet, with wild tobacco growing at its mouth and several remarkable ferns, of one of which the fronds were fourteen feet long. The fauna illustrated the widespread distribution in the highlands of Borneo of Himalayan forms. A magnificent view was had from the moss-clad summit of the mountain of distant ranges. Some natives reported having heard a tiger roaring in the neighborhood, but Mr. Hose found that the sound proceeded from a gigantic toad, which measured fourteen inches and a half round the body.

# FOSSIL FORESTS OF THE YELLOWSTONE.

By Prof. SAMUEL E. TILLMAN.

THE fossil forests of the Yellowstone Park are among its most interesting features, but they are as yet not within ready reach of the tourist, and so little has been published about them that only a few have definite knowledge of them. It is accordingly believed that the accompanying notes in regard to them will be of general interest.

The locality to which the term fossil forest has especial reference is along the west rim wall of the valley of the Lamar River,

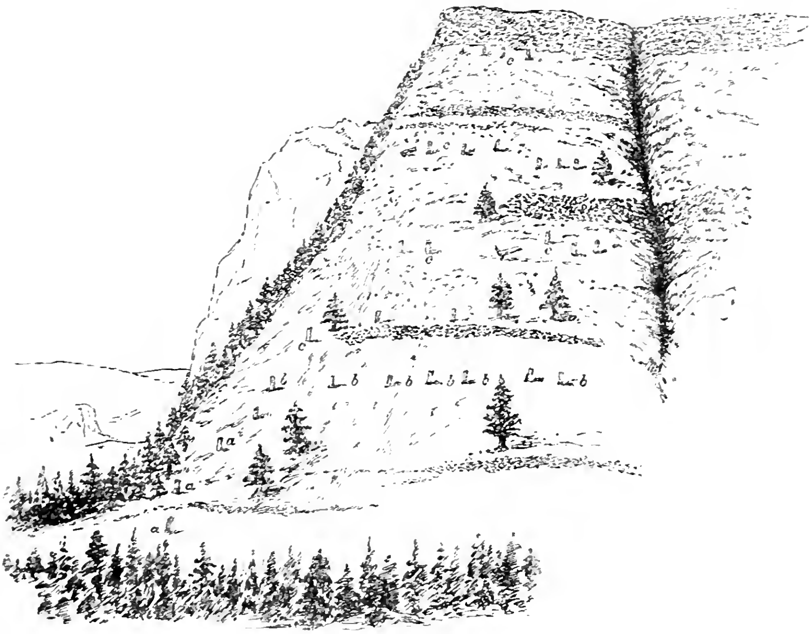

Fig. 1.—Point of Specimen Ridge: *a*, *b*, *c*, Petrified Stumps.

or East Fork of the Yellowstone, opposite the mouth of Soda Butte Creek. The same arrangement of petrified stumps and trees is, however, found at many other places in this region separated by considerable distances—as much as thirty miles. The general physical conditions that brought about the existing state of affairs is so plainly shown by the present exposures that they can not be mistaken.

The petrifactions were visited at several places, but the description appended refers to a part of the ridge designated on the map of the Geological Survey as Specimen Ridge, at a point about six miles east of the junction of the Lamar and Yellowstone Rivers.

The fossil trees exposed at this point are along the upper slope of the southern wall of Lamar Valley. The slope here makes an angle of about thirty-three degrees with the horizon, and is about nine hundred feet long. The petrifactions are standing all the way up this slope, interspersed with the living conifers of to-day, represented at Fig. 1. At first sight it appears that either these ancient trees grew upon the slope now exposed, and that there had been no change in the slope from that day to this, or that the present had brought back *exactly the same surface conditions* as existed when the now silicified trees were alive. Such an apparently simple conclusion would, however, involve more remarkable phenomena than are yielded by the true explanation.

A little consideration, taken in connection with the formation of the bluffs that connect Lamar Valley with the higher lands to

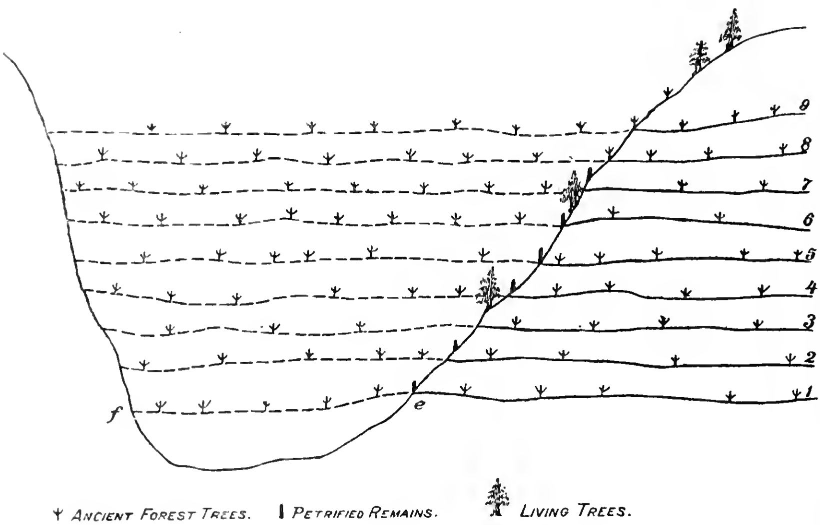


Fig. 2.

the south and west, shows clearly the action that has placed the living and petrified trees upon the same slope at this and at many other points in the region.

A series of forests has grown upon successive levels, each level having been produced by an accumulation of volcanic material which destroyed the then existing forest. This explanation will be readily understood from Fig. 2. The level upon which the first forest grew is indicated by 1. The level of the volcanic accumulation which destroyed this growth of trees is shown at 2. Upon this second level came another growth of trees, which in turn was destroyed by the accumulation extending to the level 3. Still another forest grew upon 3, which in course of time was destroyed. This alternate growth and destruction was repeated

until at this place (Specimen Ridge) there grew and were destroyed certainly *nine* successive forests and very probably twelve. This is all indicated in Fig. 2.

The number of growths was determined in two ways: first, where the roots of the petrified trees are shown at different heights in the same vertical plane the horizons of growth may be counted directly; second, when the roots do not show, a sufficient vertical distance must be allowed between horizons to insure that the projecting body at one level does not have its roots in the horizon next below.

In the second method it was sometimes possible to settle the point by following the volcanic ledges to the right or left until a petrifaction with roots exposed, decided the question.

In later times, when the volcanic accumulations had ceased and the agents of denudation began their work, the layers of lava and the great sheets of volcanic conglomerate were gradually eaten away, and a valley formed extending in the figure from *e* to *f*. Along the southern slope of this valley are growing the conifers of to-day, and on the same slope also stand the petrified stumps, the relics of many successive forest growths. Thus, though the living and the petrified trees now stand on a common slope, the latter did not, like the former, all grow at the same time, but succeeded each other at intervals of considerable length.

These standing silicified stumps and fallen trees were found varying in diameter from one to seven feet. Two sections of trees were found so perfect that the rings of annual growth throughout could be counted, except a few, perhaps fifteen or twenty, near the heart and bark. One tree, measuring three feet in diameter, had two hundred and twenty-two rings of growth; and another, of three feet five inches diameter, had two hundred and forty-three—this without any allowance for a few missing rings at the center and toward the bark. The larger of these trees was only about half the size of the largest seen. Many were found varying in diameter from five to seven feet, but none of this size were seen exposing the rings throughout the entire section. Judging from the closeness of the rings in certain well-preserved portions of these larger trees, many of them must have been at least five hundred years in attaining their growth, if the rings were truly annual. Taking one half this number, two hundred and fifty years, as the more probable age of the successive forests at this point, it is seen that the earliest of these trees were living more than two thousand years before the latest, during which time there were alternating conditions of growth and accumulation of volcanic material.

This estimate makes no allowance for the time necessary for the formation of a soil upon the volcanic material, which at first

sight would seem necessary for the support of such a vigorous vegetation. It is not probable, however, that any considerable time was necessary for this purpose, for, with rare exceptions, each succeeding forest took root and began to grow very promptly after the destruction of its predecessor. In most cases the destroying flood consisted largely of mud, ashes, conglomerate, and other volcanic material, which formed an excellent base for vegetation, and it was doubtless covered with a luxuriant growth as soon as it was dried or cooled sufficiently, and this would require only a short time.

In some cases the trees grew upon a true lava base; but even then the growth began very promptly after the flow; for the upper surface of the lava soon weathered sufficiently for vegeta-

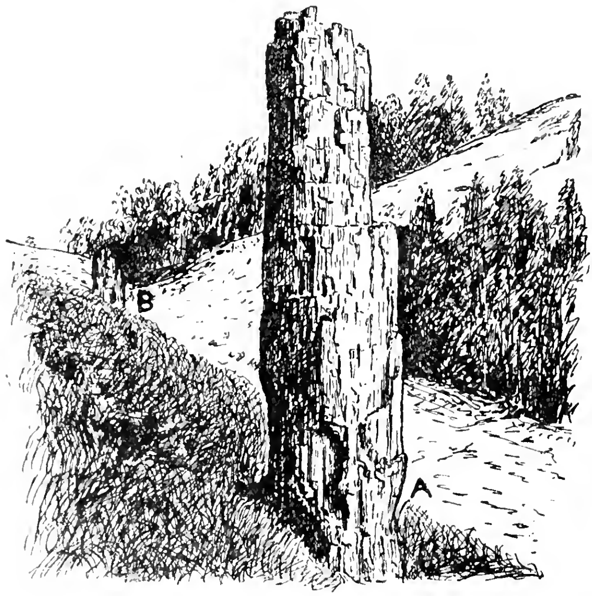


Fig. 3.—A, B, Petrified Stumps near Yancey's, Twenty Miles East of the Mammoth Springs.

tion to gain a footing. The growing trees then too, as at present, were frequently supported by very shallow and wide-spreading roots. We now often see large trees with such roots standing over rocks barely covered with soil; the petrified trees exhibit the same phenomena.

Besides the standing stumps, the fossil forests contain many specimens lying upon the ground. Some of these were petrified standing and then fell, and others were down before the petrifying action began. It is frequently possible to distinguish between the two by position: the first lie upon the present slope of the ground; the second often show the original surface and consequently pro-

ject at different levels from the bluff and making angles with the present slope.

It is rather remarkable that only one standing stump was seen with a limb in position. This is probably explained by the fact that the living trees were generally covered by the volcanic material to a less height than that of their lowest limb, and consequently the upper portions of the trees were not preserved, but suffered aërial decomposition. In general, the silicified tree would crumble down as rapidly as the rock material surrounding it would wear away, so that only short stumps would now be found, though greater lengths were petrified. The absence of limbs in position is, however, mainly due to the fact first named. In the cases of trees that were petrified after they had fallen, both limbs and roots projecting upward were seen in position.

Specimens of rotten wood far progressed toward complete decomposition were found perfectly preserved in stone. Petrifactions of bark were of frequent occurrence, and the channeling and borings of worms or insects were beautifully preserved in some of the specimens, so that we literally have *petrified wormholes.*

In some of the finer water-collected *débris* were found beautifully preserved impressions of leaves, showing two kinds of deciduous trees, of course entirely different from any trees now growing in the region. The impressions of conifer leaves and the petrified part of the same wood were also found.

These fossil tree remains are found over a wide area in the park region. Along Soda Butte Creek they stand up the slope from each bank, but along the Lamar River, below the mouth of this creek, they exist on the left bank only, the imbedding material having been entirely removed from the right bank by erosion. The lowest level at which a petrified tree was seen in position was on the left bank of the Yellowstone, opposite the mouth of Hell-roaring Creek, at an approximate altitude of 6,100 feet. The highest was seen opposite the mouth of Soda Butte Creek at an altitude of about 8,180 feet. These trees are twelve or fifteen miles apart, and the original slope of the ground between them is not known, so that they can not be taken to fix the highest and lowest levels of the original forest growths in this area.

At Specimen Ridge, where the closest examination was made, the lowest stump seen in position was at an altitude of about 7,000 feet, and the highest a little over 7,500 feet. There were here between these limiting growths certainly nine successive forests, and of course an equal or greater number of incursions of imbedding materials.

In what has gone before I have not attempted to designate

definitely the imbedding material which ingulfed and destroyed the living trees, and in which the petrifactions are now preserved. It is, as a rule, a volcanic conglomerate, or more properly a volcanic agglomerate. Both the matrix and the imbedded particles are truly volcanic, the latter varying from dust particles through all sizes up to those of a ton or more in weight. That the material has been accumulated under the partial influence of water or liquid conditions is evident from the more or less perfect stratification which generally pervades it. But the fragments are too angular, brecciated, to have suffered transportation and deposition as subaqueous or as ordinary river deposits. The attractive and satisfactory explanation of conglomerate formation in the Utah plateau region, as given by Captain Dutton, I do not think is here applicable.

From what is said in regard to the series of forest growths, and also from the evident thinness of the layers of *débris*, it is seen that there have been many successive sheets of the material laid down at the same place. In some cases and at certain places a true lava flow has spread over the surface, but the lava ledges can at points be seen to shade into the brecciated layers. While not believing that the great mass of breccia, covering perhaps hundreds of square miles, has been literally ejected from volcanoes, as has been held in regard to such formations, I am of the opinion that the accumulation of it is the direct and immediate result of such eruption.

Extruded lava from any source, not being perfectly liquid, would cool with an irregular surface, and terminate in precipitous ledges. This unevenness of surface, combined with the original slope that must have existed to permit any flow, would soon cause the whole area involved to be abundantly floored with volcanic fragments of all sizes. During subsequent eruptions these fragments would be swept along by and with the liquid matter, commingled with dense showers of ejected material, amid heavy flows of water from accompanying rains and perhaps melting snows, to be deposited in layers at varying distances from the centers of eruption, the condition in which it is now found. Most of the material of which the agglomerate is composed I believe to have come by the ordinary process of weathering of previously erupted rocks, and then to have been commingled with finer ejected material and distributed by the floods which accompanied some if not all the outflows. The interstratified beds of varying degrees of fineness are the results of less tumultuous periods.

Such explanation involves the necessity for many centers of eruption in the park region, for the agglomerate is of wide extent, and it could not be formed at great distances from these centers.

The above facts and conclusions are from personal observations begun by me in the summer of 1891, and continued in the summer of 1892 in connection with Prof. James Mercur, of the United States Military Academy. Not until we had embodied our conclusions in an official report to the War Department did I become aware that anything had been published in relation to these forests. I then learned that Mr. W. H. Holmes, formerly of the Hayden Survey, had made reference to them in his report on The Geology of the Yellowstone Park; also that Mr. W. H. Weed, of the present Geological Survey, had contributed an article upon the subject to the School of Mines Quarterly for April, 1892. It is believed that nothing else of an explanatory or descriptive nature has been published in regard to these interesting objects.

## PRIVATE RELIEF OF THE POOR.*

By HERBERT SPENCER.

LESS objectionable than administration of poor relief by a law-established and coercive organization, is its administration by privately established and voluntary organizations—benevolent societies, mendicity societies, etc. "Less objectionable" I say, but still, objectionable: in some ways even more objectionable. For though the vitiating influences of coercion are now avoided the vitiating influences of proxy-distribution remain. If we have not a machinery so rigid as that set up by the Poor Law, yet we have a machinery. The beneficiary is not brought in direct relation with the benefactor, but in relation with an agent appointed by a number of benefactors. The transaction, instead of being one which advantageously cultivates the moral nature on both sides, excludes culture of the moral nature as much as is practicable, and introduces a number of bad motives. Note the ill workings of the system.

As with the Poor Law (especially the old Poor Law), those who were distressed but thrifty and well conducted got no help, while help came to the improvident and ill-conducted; so with philanthropic societies in general. The worthy suffer rather than ask assistance; while the worthless press for assistance and get it. The Mansion House Fund of 1885–'86, for instance, was proved to have gone largely for the support of "idlers, spendthrifts, and drunkards." "They did not see why they should not have some of the money going as well as their neighbors." In some cases applicants "*demanded* their share." Where, as in another case,

* From the author's Principles of Ethics, vol. ii, just published by D. Appleton & Co.

employment was offered, less than one fifth proved to be good for anything; showing that the unemployed, so generally pitied as ill-used by society, are unemployed because they either can not or will not work; and showing, by implication, that charitable agencies enable them to evade the harsh but salutary discipline of Nature.

The encouragement of hypocrisy, which goes along with this neglect of the good poor who do not complain and attention to the bad poor who do, becomes conspicuous when religious professions are found instrumental to obtainment of alms. Clergy and pious women, easily deluded by sanctimonious talk, favor those who are most skilled in utterance of spiritual experiences, and in benedictions after receiving gifts. Hence a penalty on sincerity and a premium on lying; with resulting demoralization.

This evil is intensified by sectarian competition. There are competing missions which collect and distribute money to push their respective creeds, and bribe by farthing breakfasts and penny dinners. Nearly half the revenue of one mission is distributed in credit tickets, and "if the recipient wishes to cash his ticket, he can not do so until after the evening service": this vicious system being carried even to the extent that the visitors try "to force its tickets on the most respectable and independent people"—pauperizing them to make hypocritical converts of them. Said one woman, poor but clean and tidy, who saw how the emissaries of the Church favored the good-for-nothings: "I didn't want any of the good lady's tickets . . . but it's very 'urtful to the feelings to see that careless drinking people living like 'ogs gets all, and them as struggles and strives may go without." And not only does there result a discouragement of virtue and an encouragement of vice, but there results a subsidizing of superstitions. Unless all the conflicting beliefs thus aided are right, which is impossible, there must be a propagation of untruth as well as a rewarding of insincerity.

Another evil is that easy-going people are *exploité* by cunning fellows who want to make places for themselves and get salaries. A crying need is found; prospectuses are widely distributed; canvassers press those on whom they call; and all because A, B, C, etc., who have failed in their careers, have discovered that they can get money by playing the parts of manager, secretary, and collector. Then, if the institution vehemently urged is established, it is worked in their interest. But it is not always established. As there are bubble mercantile companies, so there are bubble philanthropic societies—societies kept up for a time merely for the purpose of getting subscriptions. Nay, on good authority I learn that there are gangs of men who make it their business to float bogus charities solely to serve their private ends.

Not even now have we reached the end of the evils. There is the insincerity of those who furnish the funds distributed: flunkyism and the desire to display being often larger motives than beneficent feeling. These swindling promoters when writing to wealthy men for contributions, take care to request the honor of their names as vice-presidents. Even where the institutions are genuine, the giving of handsome subscriptions or donations, is largely prompted by the wish to figure before the world as generous, and as filling posts of distinction and authority. A still meaner motive co-operates. One of the *nouveaux riches*, or even one whose business is tolerably prosperous, takes an active part in getting up, or in carrying on, one of these societies supposed to be originated purely by benevolence, because he likes the prospect of sitting on a committee presided over by a peer, and perhaps side by side with the son of one. He and his wife and his daughters enjoy the thought of seeing his name annually thus associated in the list of officers; and they contemplate this result more than the benefits to be given.

There are kindred vitiations of other organizations having beneficent aims—orphanages, provisions for unfortunate and aged tradesmen, etc. Here again, the least necessitous, who have many friends, are usually those to benefit, and the most necessitous, who have no friends, are neglected. Then there is the costliness and corruption of the selecting process—expensive and laborious canvassing, exchange of votes, philanthropic log-rolling. Evidently the outlay for working the system, in money and effort, is such as would be equivalent to a maintenance for many more beneficiaries, were it not thus wasted in machinery.

Nor is it otherwise with institutions thought by most people to be indisputably beneficial—hospitals and dispensaries. The first significant fact is that thirty per cent of the people of London are frequenters of them; and the largeness of this proportion makes it clear that most of them, not to be ranked as indigent, are able to pay their doctors. *Gratis* medical relief tends to pauperize in more definite ways. The out-patients begin by getting physic and presently get food; and the system "leads them afterward openly to solicit pecuniary aid." This vitiating effect is proved by the fact that during the forty years from 1830 to 1869, the increase in the number of hospital patients has been five times greater than the increase of population; and as there has not been more disease, the implication is obvious. Moreover, the promise of advice for nothing attracts the mean-spirited to the extent that "the poor are now being gradually ousted out of the consulting room by well-to-do persons." People of several hundreds a year, even up to a thousand, apply as out-patients, going in disguise: twenty per cent of the out-patients in one large hospital having

"given false addresses" for the purpose of concealing their identity. Swarming as patients thus do, it results that each gets but little attention: a minute being the average for each, sometimes diminished to forty-five seconds. Thus those for whom the *gratis* advice is intended get but little. Often "the assistance given is merely nominal"; and "is both a deception on the public and a fraud upon the poor." These gratuitous medical benefits, such as they are, "are conferred chiefly by the members of the unpaid professional staffs" of these charities. Some of them prescribe at the rate of three hundred and eighteen patients in three hours and twenty minutes—a process sufficiently exhausting for men already hard-worked in their private practice, and sufficiently disheartening to men with little private practice, who thus give without payment aid which otherwise they would get payment for, very much needed by them. So that the six hundred thousand pounds a year of the metropolitan hospitals, which, if the annual value of the lands and buildings occupied were added would reach very nearly a million, has largely the effect of demoralizing the patients, taking medical care from those it was intended for and giving it to those for whom it was not, and obliging many impecunious doctors and surgeons to work hard for nothing.*

These various experiences, then, furnished by societies and institutions supported by voluntary gifts and subscriptions, unite to show that whatever benefits flow from them are accompanied by grave evils—evils sometimes greater than the benefits. They force on us the truth that, be it compulsory or non-compulsory, social *machinery* wastes power, and works other effects than those intended. In proportion as beneficence operates indirectly instead of directly, it fails in its end.

Alike in the foregoing sections and in the foregoing parts of this work, there has been implied the conclusion that the beneficence which takes the form of giving material aid to those in distress, has the best effects when individually exercised. If, like mercy, it "blesses him that gives and him that takes," it can do this in full measure only when the benefactor and beneficiary stand in direct relation. It is true, however, that individual beneficence often falls far short of the requirements, often runs into excesses, and is often wrongly directed. Let us look at its imperfections and corruptions.

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* The evidence here summarized will be found in Medical Charity: Its Abuses, and how to remedy them, by John Chapman, M. D. Some of the sums and numbers given should be greatly increased; for since 1874, when the work was published, much hospital extension has taken place.

The most familiar of these is the careless squandering of pence to beggars, and the consequent fostering of idleness and vice. Sometimes because their sympathies are so quick that they can not tolerate the sight of real or apparent misery; sometimes because they quiet their consciences and think they compound for misdeeds by occasional *largesse;* sometimes because they are moved by that other-worldliness which hopes to obtain large gifts hereafter by small gifts here; sometimes because, though conscious of mischief likely to be done, they have not the patience needed to make inquiries, and are tempted to end the matter with a sixpence or something less; men help the bad to become worse. Doubtless the evil is great, and weighs much against the individual exercise of beneficence—practically if not theoretically.

The same causes initiate and maintain the begging-letter impostures. Occasional exposures of these in daily papers might serve as warnings; but always there is a new crop of credulous people who believe what they are told by cunning dissemblers, and yield rather than take the trouble of verification; thinking, many of them, that they are virtuous in thus doing the thing which seems kind, instead of being, as they are, vicious in taking no care to prevent evil. That the doings of such keep alive numbers of scamps and swindlers, every one knows; and doubtless a considerable set-off to the advantages of individual beneficence hence arises.

Then, again, there meets us the objection that if there is no compulsory raising of funds to relieve distress, and everything is left to the promptings of sympathy, people who have little or no sympathy, forming a large part of the community, will contribute nothing; and will leave undue burdens to be borne by the more sympathetic. Either the requirements will be inadequately met or the kind-hearted will have to make excessive sacrifices. Much force though there is in this objection, it is not so forcible as at first appears. In this case, as in many cases, wrong inferences are drawn respecting the effects of a new cause, because it is supposed that while one thing is changed all other things remain the same. It is forgotten that in the absence of a coercive law there often exists a coercive public opinion. There is no legal penalty on a lie, if not uttered after taking an oath; and yet the social disgrace which follows a convicted liar has a strong effect in maintaining a general truthfulness. There is no prescribed punishment for breaking social observances; and yet these are by many conformed to more carefully than are moral precepts or legal enactments. Most people dread far more the social frown which follows the doing of something conventionally wrong, than they do the qualms of conscience which follow the doing of something intrin-

sically wrong.* Hence it may reasonably be concluded that if private voluntary relief of the poor replaced public compulsory relief, the diffused sentiment which enforces the one would go a long way toward maintaining the other. The general feeling would become such that few, even of the unsympathetic, would dare to face the scorn which would result did they shirk all share of the common responsibility; and while there would probably be thus insured something like due contributions from the indifferent or the callous, there would, in some of them, be initiated, by the formal practice of beneficence, a feeling which in course of time would render the beneficence genuine and pleasurable.

A further difficulty presents itself. "I am too much occupied," says the man of business when exhorted to exercise private beneficence. "I have a family to bring up; and my whole time is absorbed in discharging my responsibilities, parental and other. It is impossible for me, therefore, to make such inquiries as are needful to avoid giving misdirected assistance. I must make my contribution and leave others to distribute." That there is force in the reply can not be denied. But when we call to mind the common remark that if you want anything done you must apply to the busy man rather than to the man of leisure, we may reasonably question whether the busy man may not occasionally find time enough to investigate cases of distress which are forced on his attention. Sometimes there may even result, from a due amount of altruistic action, a mental gain conducive to efficiency in the conduct of affairs.

At any rate it must be admitted that individual ministration to the poor is the normal form of ministration; and that, made more thoughtful and careful, as it would be if the entire responsibility of caring for the poor devolved upon it, it would go a long way toward meeting the needs: especially as the needs would be greatly diminished when there had been excluded the artificially generated poverty with which we are surrounded.

But now, from this general advocacy of individual giving *versus* giving by public and quasi-public agencies, I pass to the special advocacy of the natural form of individual giving—a form which exists and which simply needs development.

Within the intricate plexus of social relations surrounding

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* A most instructive and remarkable fact, which illustrates this general truth at the same time that it illustrates a more special truth, is that respecting the rudest of the Musheras of India, who have no form of marriage, but among whom "unchastity, or a change of lovers on either side, when once mutual appropriation has been made, is a thing of rare occurrence"; and, when it does occur, causes excommunication. So that among these simple people, public opinion in respect of the marital relation is more potent than law is among ourselves. (For account of the Musheras see Calcutta Review, April, 1888.)

each citizen, there is a special plexus more familiar to him than any other, and which has established greater claims on him than any other. Every one who can afford to give assistance, is brought by his daily activities into immediate contact with a cluster of those who by illness, by loss of work, by a death, or by other calamity, are severally liable to fall into a state calling for aid; and there should be recognized a claim possessed by each member of this particular cluster.

In early societies, organized on the system of *status*, there went, along with the dependence of inferiors, a certain kind of responsibility for their welfare. The simple or compound family group, formed of relatives standing in degrees of subordination, and usually possessing slaves, was a group so regulated that while the inferiors were obliged to do what they were told, and receive what was given to them, they usually had a sufficiency given to them. They were much in the position of domestic animals in respect of their subjection, and they were in a kindred position in respect of due ministration to their needs. Alike in the primitive patriarchal system and in the developed feudal system, we see that the system of *status* presented the general trait, that while dependents were in large measure denied their liberty, they were in large measure supplied with the means of living. Either they were directly fed and housed, or they were allowed such fixed proportion of produce as enabled them to feed and house themselves. Possession of them unavoidably brought with it care for them.

Along with gradual substitution of the system of contract for the system of *status*, this relation has been changed in such manner that while the benefits of independence have been gained the benefits of dependence have been lost. The poorer citizen has no longer any one to control him; but he has no longer any one to provide for him. So much service for so much money, has become the universal principle of co-operation; and the money having been paid for the service rendered, no further claim is recognized. The requirements of justice having been fulfilled, it is supposed that all requirements have been fulfilled. The ancient *régime* of protection and fealty has ceased, while the modern *régime* of beneficence and gratitude has but partially replaced it.

May we not infer, with tolerable certainty, that there has to be re-instituted something akin to the old order in a new form? May we not expect that without re-establishment of the ancient power of superiors over inferiors, there may be resumed something like the ancient care for them? May we not hope that without the formation of any legal ties between individuals of the regulating class, and those groups whose work they severally

regulate in one or other way, there may come to be formed stronger moral ties? Already such moral ties are in some measure recognized. Already all householders moderately endowed with sympathy, feel bound to care for their servants during illness; already they help those living out of the house who in less direct ways labor for them; already from time to time small traders, porters, errand-boys, and the like, benefit by their kind offices on occasions of misfortune. The sole requisite seems to be that the usage which thus shows itself here and there irregularly, should be called into general activity by the gradual disappearance of artificial agencies for distributing aid. As before implied, the sympathetic feelings which have originated and support these artificial agencies, would, in their absence, vitalize and develop the natural agencies. And if with each citizen there remained the amount now taken from him in rates and subscriptions, he would be enabled to meet these private demands: if not by as large a disbursement, yet by a disbursement probably as large as is desirable.

Besides re-establishing these closer relationships between superior and inferior, which during our transition from ancient slavery to modern freedom have lapsed; and besides bringing beneficence back to its normal form of direct relation between benefactor and beneficiary; this personal administration of relief would be guided by immediate knowledge of the recipients, and the relief would be adjusted in kind and amount to their needs and their deserts. When, instead of the responsibility indirectly discharged through poor-law officers and mendicity societies, the responsibility fell directly on each of those having some spare means, each would see the necessity for inquiry and criticism and supervision: so increasing the aid given to the worthy and restricting that given to the unworthy.

And here we are brought face to face with the greatest of the difficulties attendant on all methods of mitigating distress. May we not by frequent aid to the worthy render them unworthy; and are we not almost certain by helping those who are already unworthy to make them more unworthy still? How shall we so regulate our pecuniary beneficence as to avoid assisting the incapables and the degraded to multiply?

I have in so many places commented on the impolicy, and indeed the cruelty, of bequeathing to posterity an increasing population of criminals and incapables, that I need not here insist that true beneficence will be so restrained as to avoid fostering the inferior at the expense of the superior—or, at any rate, so restrained as to minimize the mischief which fostering the inferior entails.

Under present circumstances the difficulty seems almost insurmountable. By the law-established and privately established agencies, coercive and voluntary, which save the bad from the extreme results of their badness, there have been produced unmanageable multitudes of them, and to prevent further multiplication appears next to impossible. The yearly accumulating appliances for keeping alive those who will not do enough work to keep themselves alive, continually increase the evil. Each new effort to mitigate the penalties on improvidence, has the inevitable effect of adding to the number of the improvident. Whether assistance is given through State-machinery, or by charitable societies, or privately, it is difficult to see how it can be restricted in such manner as to prevent the inferior from begetting more of the inferior.

If left to operate in all its sternness, the principle of the survival of the fittest, which, as ethically considered, we have seen to imply that each individual shall be left to experience the effects of his own nature and consequent conduct, would quickly clear away the degraded. But it is impracticable with our present sentiments to let it operate in all its sternness. No serious evil would result from relaxing its operation, if the degraded were to leave no progeny. A short-sighted beneficence might be allowed to save them from suffering, were a long-sighted beneficence assured that there would be born no more such. But how can it be thus assured? If, either by public action or by private action, aid were given to the feeble, the unhealthy, the deformed, the stupid, on condition that they did not marry, the result would manifestly be a great increase of illegitimacy; which, implying a still more unfavorable nurture of children, would result in still worse men and women. If instead of a "submerged tenth" there existed only a submerged fiftieth, it might be possible to deal with it effectually by private industrial institutions, or some kindred appliances. But the mass of effete humanity to be dealt with is so large as to make one despair; the problem seems insoluble.

Certainly, if solvable, it is to be solved only through suffering. Having, by unwise institutions, brought into existence large numbers who are unadapted to the requirements of social life, and are consequently sources of misery to themselves and others, we can not repress and gradually diminish this body of relatively worthless people without inflicting much pain. Evil has been done and the penalty must be paid. Cure can come only through affliction. The artificial assuaging of distress by State-appliances, is a kind of social opium-eating, yielding temporary mitigation at the eventual cost of intenser misery. Increase of the anodyne dose inevitably leads by and by to increase of the evil; and the

only rational course is that of bearing the misery which must be entailed for a time by desistance. The transition from State-beneficence to a healthy condition of self-help and private beneficence, must be like the transition from an opium-eating life to a normal life—painful but remedial.

## ARE THERE EVIDENCES OF MAN IN THE GLACIAL GRAVELS?

By Major J. W. POWELL.

THE geologist studying in the Rocky Mountains is ever astonished at the rapid degradation of mountain forms. Cliffs, peaks, crags, and rocky scaurs are forever tumbling down. The rocks break asunder above and roll down in great slides on the flanks and about the feet of the mountains. As the slopes are thus diminished, gradually the slides are covered with soil, in part through the decay of the rocks themselves, in part by wind-drifted sands, but perhaps in chief part by the washing of the soils above. In this manner a great mountain is ultimately buried by overplacement. This overplacement gradually washes down, to be distributed on still lower grounds, but it is replaced from above from the newly formed soils. The process goes on until the mountain is degraded into hills and the streams have carried away the greater part of the material of the ancient mountain. Now, in studying these mountains, the geologist is always on his guard to distinguish overplacement from foundation structure. When the mountains are all gone the hills are degraded in the same manner, and the process continues until a grand base-level is established, below which degradation can not take place; then the mountains and hills have all been carried away by rivers to the sea. As mountains and hills are degraded, so valley slopes are brought down. The river, meandering now on this side and now on that, increases the length of its course, as every bend throughout the valley is cut back; but ultimately bend works back against bend, until shorter channels are produced. By cut-off channels the course of the river is diminished; by increasing its meanders the course of the river is lengthened; but in the grand operation the one about compensates for the other. In this manner the river is forever rearranging the flood plain. The banks of the stream, left dry by the vicissitudes of river cutting, tumble down, and a bank goes through a process much like that of the mountain slope; and the geologist is ever on the lookout to distinguish overplacement from the rocks of the foundation structure. There are many conditions where this distinction is plain,

but there are many other conditions where it is obscure. Let us see how some of these obscurities arise.

In the United States and in British America there is a vast district of country covered with glacial drift. In a period known to geologists as the Glacial epoch deep snows and gigantic accumulations of ice extended from a region far to the northward down into the United States, nearly to the mouth of the Ohio River. The margin of this great ice field stretched from this central point eastward and northward to the Atlantic Ocean, and westward and northward to the Great Plains, while the Rocky Mountains were covered with great ice fields. This enormous ice sheet was ever working southward, and ever melting along its southern boundary. As it moved southward it plowed the mountains, dug down the hills, and generally filled the valleys with the *débris*; and it spread over much of the great area a vast sheet of rounded gravels, sands, and clays; and it fed the streams from the border of the ice sheet with fine silt that was distributed along the valleys to the Gulf of Mexico. This glacial flour is now recognized as the loess of the South. Since the disappearance of the great ice sheet the glacial formations that were made by it cover much of the dry land. Now, these glacial formations, being composed of incoherent bowlders, gravels, sands, and clays, are pretty easily distinguished from the underlying, more indurated rocks; but rains, brooks, creeks, and rivers have been at work carving new valleys, and remodeling the bluffs, hills, cliffs, and mountains of all the country, and in the process have distributed over the land formed by the glacial ice extensive bodies of overplacement. This overplacement is incoherent, like the glacial formations. There is no difficulty in distinguishing the overplacement from the primeval foundation, but there is great difficulty in distinguishing it from the glacial formations, and it requires nice powers of observation to always make the distinction with certainty. The criteria for distinguishing overplacement from the original glacial formations have been gradually discovered and formulated in the last few years.

In 1882, by act of Congress, the Geological Survey was authorized and directed to make a geological map of the United States. The survey entered upon this work in different parts of the country. Among many problems before it, one of the more important was that of mapping the glacial formations, and in order to do it two things were necessary: First, it was necessary to distinguish the glacial formations from modern overplacement; second, it was necessary to study the history of the glacial action and the various structures which the ice produced, for there are many—such as moraines, osars, kames, and bodies of till, sand, gravel, and bowlders; and it was sought to discover the history of their forma-

tion, and especially the history of the entire Glacial epoch. The members of the Geological Survey engaged upon the general work were only to a limited extent occupied with this problem. In the special fields where they were engaged in studying the primeval foundation rocks they also studied the glacial formations and the modern overplacements. But the field was very large, and many geologists in the country had already made observations and engaged in researches of this character. Most of these geologists were professors in the various colleges of the country, and it was decided by the director to enlist these professorial geologists as far as possible to continue the work and solve these problems for the general survey of the United States upon the foundation of observation already begun by them. For this purpose Prof. Chamberlin, then of Beloit College, with Prof. Salisbury, his associate, and many other professorial assistants, were engaged upon the work. Prof. Shaler, of Harvard University, was also enlisted, with a large corps of assistants. Prof. Emerson, of Amherst College, was likewise enlisted, with his assistants; and Prof. Davis, of Harvard University, with his assistants, also took a part. Mr. Gilbert, of the Geological Survey, with his assistants, was studying the lake basins of the far West, but, as their history was involved in the history of the glacial formations, he incidentally took part in this work. Mr. McGee, permanently employed upon the survey, with his assistants, was engaged in studying the estuarine and coastal-plain formations of the Atlantic slope, and he soon discovered that they were involved with the glacial deposits that had come down from the Appalachian Mountains. Besides the men thus occupied, many other volunteers, as professors and students, took part in the work, now here, now there; so that altogether more than fifty different men engaged in the solving of these great problems. Nearly all the men who engaged in this work soon discovered that the preliminary problem was to formulate the criteria by which modern overplacement is to be distinguished from original glacial formation. As this proceeded it was further discovered that much of the confusion in the study of the glacial rocks themselves was cleared away, and that it was possible to read the record of the old Glacial epoch in such a manner as to discover its history.

So the work went on year after year, in small part by the regular employees of the survey, in chief part by a professorial corps, aided by many volunteers, often university students. Then many of the State geologists were enlisted, and the work proceeded, until at last a vast body of facts has been collected. The men often conferred with one another and visited doubtful points together. The officers of the Geological Survey, the professorial geologists, and the State geologists thus associated themselves

voluntarily, and made many excursions together. For example, Mr. McGee believed that he had made some discoveries in Alabama and Mississippi which were inconsistent with conclusions reached by State geologists. Thereupon he conferred with Messrs. Hilgard, formerly of Mississippi, now of the University of California; Smith, of Alabama; Holmes, of North Carolina; Safford, of Tennessee; Hill, of Texas; and Ward, paleobotanist of the Geological Survey; and they visited the region together, all having distinct views somewhat differing from one another. They examined the problems concerning which differences of opinion had arisen, and they all united in a common conclusion. Subsequently Messrs. Chamberlin and Salisbury visited the same region in company with Mr. McGee, and came to substantial agreement with the first party. Such instances of harmonious co-operation have occurred again and again in all portions of the glaciated area. The whole body of men engaged in the research worked together for a common purpose, and were unwilling to publish material conclusions until the facts could be submitted to many minds. They worked with a harmony and a patience for dissenting opinion worthy of such a body of scientific men. Mr. Chamberlin, first the Professor of Geology at Beloit College, afterward President of the University of Wisconsin, and now in charge of the geological department of the new University of Chicago, had the largest share in all this work; he gave more time to it himself and he employed more assistants than any one else; in fact, he was considered the Nestor of the work. He had long before been the State Geologist of Wisconsin, where glacial formations are highly developed, and had made a special study of the subject, and all the workers in the field deferred largely to his judgment in suggesting methods of research.

Occasionally some observer failed to make the necessary discriminations, and dropped out of the work. Among others whom Prof. Chamberlin enlisted was Prof. G. F. Wright, of Oberlin College, who devoted some summer months to these investigations. Now, some of the observations made by Prof. Wright were of value, but he seemed to fail to distinguish overplacement from glacial formation; and, after trying him for two or three seasons, his labors were dispensed with. Thereupon Prof. Wright commenced the preparation of a popular work upon the history of the Ice period. When this came to the knowledge of Prof. Chamberlin, he demurred. Still, Prof. Wright continued his work, and ultimately published his book. On its appearance it was found that he had ignored the conclusions of his co-workers—had practically denied the accuracy of their observations—and had published a work on the history of the Ice period which they believed to be erroneous and misleading. But they let the subject pass

with no unfavorable criticism, believing that ultimately the grand results of the combined labors of so many men, when published, would correct all errors.

There is another phase to this question, connected with the science of archæology. I have already set forth the distinction which geologists recognize between overplacement formations and fundamental formations. Certain archæologic problems which have sprung up in late years in the United States are profoundly affected by the discovery and formulation of these distinctions. Many years ago a local observer at Natchez, Miss., claimed to have discovered a human skeleton in the loess of a bluff on the Mississippi River. The loess is a formation contemporaneous with the glacial formation of the North, as previously explained. The discovery of a human skeleton in this situation was believed to prove that man dwelt in the valley of the Mississippi during the loess-forming epoch. The discovery seemed to be of so much importance that the site was visited by Sir Charles Lyell, who on examination at once affirmed that the skeleton was not found in the loess itself, but in the overplacement or modified loess—that is, in the talus of the bluff; and all geologists and archæologists have accepted the decision.

From time to time other supposed discoveries were made in this country; but one after another was abandoned, until a series of discoveries were made along the line of hills which stretch from the Hudson to the James River. This line of hills marks an interesting geological displacement. The country to the seaward of the line has been differentially displaced from the country mountainward by an uplift on the Appalachian side or a downthrow on the ocean side, or both. The displacement has given rise to many rapids and falls in the streams. Above this line of displacement the waters are not navigable, the declivity of the streams being too great; below, tidewater always flows to the foot of the hills. Now, along this line of hills, back and forth from the upper country to the lower, are many glacial gravels, many hills of ancient river gravels, and many hills of estuarine gravels, all of Glacial age. But there are other gravels of still greater age intimately associated with them, and in making the geological survey of the country it became necessary to distinguish the older gravels of Neocene and Cretaceous age from the younger gravels of the Ice period, and it also became necessary to distinguish the overplacement of modern times. In these same gravels certain archæologists had discovered what they believed to be palæolithic implements; and as some of the gravels were known to be of Glacial age, they supposed them all to be Glacial, and that they thus had evidence that man inhabited the country during the Glacial epoch. These implements were gathered

in very great numbers and collected in various museums in the United States, and many collections were sent abroad to the great museums of the world. Several different collectors engaged in this enterprise for some years, and acquired great reputation for their proof of the antiquity of man on this continent, and for their zeal in discovering the evidence; and to recompense them for this work they were made members of many scientific societies throughout the world, and decorated with ribbons, and some were knighted. Geologists, however, held the question more or less in abeyance, not feeling sure of the geological evidence for the age of the formations in which the supposed stone implements were found. Then other discoveries were made in Minnesota and elsewhere; and finally geologists, with some misgivings and many ifs and perchances, accepted the conclusion that Glacial man in America was a reality.

But now the problem of these formations had to be studied geologically in making the map of the United States, for they had to be represented thereon. They were soon found to be of different ages, but had been confused by reason of the overplacement which is so abundant everywhere. At the same time a new class of archæologic investigations began. The first new work of the character was undertaken in the neighborhood of Washington, on Piny Branch. It had been discovered that the gravels of this locality were of Cretaceous age, and if the flaked stones supposed to be found therein were really deposited *in situ*, then man in America was not only of Glacial age but of Cretaceous age, for the very same class of implements which the Indians made two centuries ago in the valley of the Potomac were also supposed to be found in the Cretaceous gravels as well as in the gravels of the Glacial epoch. Thereupon Mr. Holmes, of the Bureau of Ethnology in the Smithsonian Institution—not a member of the Geological Survey—undertook the investigation, and he commenced by trenching the hills, and worked patiently for months at the problem. He proved that all the supposed stone implements belonged, not in the foundation rocks of Cretaceous age, but in the overplacement. Man, then, was not of Cretaceous age. While these investigations were in progress the American Association and the International Geologic Congress met in Washington, and many of the scientific men visited the ground. Most of the assistants of the Geological Survey visited it, and other geologists, attracted by the problem, came to Washington for the purpose; so that the whole field was surveyed and the evidence weighed by very many of the geologists of the country and of the world, and they all agreed that the stone implements belonged to the overplacement, and might possibly have been deposited within the last three hundred years.

But there were many like finds in Neocene gravels and gravels of Glacial age stretching down into Virginia and northward through Pennsylvania and New Jersey. One after another these gravel sites were explored by Mr. Holmes and his assistants in the same manner, and in every instance it was revealed that the stone objects were found in the overplacement, that in no case could they be found in the underlying rocks. Objects of the same character have been observed all over the United States. Within the last twenty years the writer of this article has seen them made by Indians in the Rocky Mountain region, and they are scattered far and wide over nearly all the gravel hills of this country. This creates a presumption that, where there are so many of modern origin, all may be modern. It has already been mentioned that certain implements of this kind had been found in gravels, supposed to be of Glacial age, in Minnesota. This is known as the Babbitt find. Finally, Mr. Holmes, together with Prof. Winchell, the State Geologist of Minnesota, visited the locality. They made careful examinations, and were entirely satisfied with the evidence that the stone objects of that site were found in overplacement.

Up to this stage one locality had not been examined with care by the new methods—the locality in Trenton, which had especially become historic by reason of the many collections made therefrom for sundry museums; and this Mr. Holmes finally visited. The implements collected had been found mainly, perhaps not wholly, along old banks of streams, and two localities of this nature had furnished many of the objects of the museums. When visited by Mr. Holmes and other geologists, implements could not be found save in the overplacement. The principal of these sites was a low bluff of gravel in the city of Trenton, and property conditions prevented thorough examination of the site by trenching; thus it seemed that final observation by the new methods was no longer possible. But at this stage the authorities of the city of Trenton commenced to dig a sewer parallel to the bluff and but a few steps back from its face—a deep trench to carry a large body of sewage to a distance where it would no longer be noxious to the inhabitants. Shortly after this work began Mr. Holmes again visited the place, and returned from time to time during its progress, and for upward of a month kept an expert assistant watching the progress of the digging. With all the examination made no stone implement was ever found. This led him to the conclusion that the flaked stones originally found on the bank really belonged to the overplacement and not to the foundation formation of Glacial age.

In the fall of 1889 the writer visited Boise City, in Idaho. While stopping at a hotel some gentlemen called on him to show

him a figurine which they said they had found in sinking an artesian well in the neighborhood at a depth, if I remember rightly, of more than three hundred feet. The figurine is a little image of a man or woman done in clay and baked. It is not more than an inch and a half in length, and is slender and delicate, more delicate than an ordinary clay pipestem, and altogether exceedingly fragile. Hold the figurine at the height of your eye and let it fall on the hearth at your feet, and it would be shivered into fragments. It was claimed that this figurine had been brought up from the bottom of an artesian well while the men were working, or about the time that they were working at the well, and that as it came out it was discovered. When this story was told the writer, he simply jested with those who claimed to have found it. He had known the Indians that live in the neighborhood, had seen their children play with just such figurines, and had no doubt that the little image had lately belonged to some Indian child, and said the same. While stopping at the hotel different persons spoke about it, and it was always passed off as a jest; and various comments were made about it by various people, some of them claiming that it had given them much sport, and that a good many "tenderfeet" had looked at it and believed it to be genuine; and they seemed rather pleased that I had detected the hoax. When I returned to Washington I related the jest at a dinner table, and afterward it passed out of my mind. In reading Prof. Wright's second book I had many surprises, but none of them greater than when I discovered that this figurine had fallen into his hands, and that he had actually published it as evidence of the great antiquity of man in the valley of the Snake River.

Consider the circumstances. A fragile toy is buried in the sands and gravels and bowlders of a torrential stream. Three hundred feet of materials are accumulated over it from the floods of thousands of years. Then volcanoes burst forth and pour floods of lava over all; and under more than three hundred feet of sands, gravels, clays, and volcanic rocks the fragile figurine remains for centuries, under such magical conditions that the very color of the burning is preserved. Then well-diggers, with a pump drill, hammer and abrade the rocks, and bore a six-inch hole down to this figurine without destroying it, and with a sand-pump bring it to the surface, to be caught by the well-digger: and Prof. Wright believes the story of the figurine, and places it on record in his book!

There are some other cases that ought to be considered, but none of them differs greatly from those given, and enough has already been said.

Now it must here be confessed that a large number of geologists some years ago were willing to acknowledge the validity of

the evidence of Glacial man. Many of them had committed themselves to it, and yet when better evidence was brought they were willing to withdraw opinions previously affirmed. The writer himself has entertained a belief in the existence of Glacial man, and there is still some evidence in California that has not yet been examined by the new methods, and it may be that this evidence is good. The writer has much linguistic material that points to the high antiquity of man on this continent. So we will all withhold final judgment until the evidence is in, being perfectly willing to believe in Glacial man, or Tertiary man, or Cretaceous man, if the evidence demands it, and being just as willing to believe that man was introduced on this continent within the last two thousand years, if the evidence demands it. What care we what the truth is, if it is the truth?

Some years ago Mr. McGee found in a lake formation of the West a stone implement, like those still made by the Indians of that country, in beds of an age not greatly differing from those of the gravels of the Eastern shore; and he published his find. In after years he had learned to distinguish overplacement from foundation formation, and he questioned his own conclusions. This was before the present controversy arose, before Mr. Holmes had so skillfully trenched the hills and shown the true age of the stone implements of the Atlantic slope; but still Mr. McGee, warned by his own observations of the difference between overplacement and under-formation, concluded that he might have been too hasty, and published a long article on the subject, from which the following extract is made:

"It is a fair presumption that any unusual object found within, or apparently within, an unconsolidated deposit is an adventitious inclusion. Every cautious field geologist accustomed to the study of unconsolidated superficial deposits quickly learns to question the verity of apparently original inclusions; he may, it is true, exhaust the entire range of hypothesis at his command without satisfying himself that the inclusion is adventitious; yet he is seldom satisfied that he has exhausted the range of possible hypothesis as to the character of the inclusion, and hesitates long before accepting any unusual association as veritable. His case is not that of the invertebrate paleontologist at work in the Palæozoic rocks, to whom a single fossil may carry conviction; for not only are the possibilities of adventitious inclusion indefinitely less in solid strata, but the mineral character of the fossil is commonly identical with that of its matrix, and so affords inherent evidence of the verity of the association. Nowhere, indeed, in the entire range of the complex and sometimes obscure and elusive phenomena of geology is there more reason for withholding final judgment based upon unusual association than in the

unconsolidated superficial deposits of the earth; and it is only where there is collateral evidence that such testimony is acceptable to the cautious student. Now, the sediments of Lake Lahontan are generally, and in Walker River cañon almost wholly, unconsolidated, and so the probabilities are against the verity of the association." *

When Prof. Wright's second book, Man and the Glacial Period, appeared, the subject was one of popular interest, and it was thought that the book would do harm. Thereupon his fellow-workers criticised the book in various scientific journals, and sometimes spoke very disparagingly of it, as being unworthy of acceptance—all intended to warn the public against a book widely advertised and circulated as the greatest contribution that had ever been made to glacial geology. The fact that in support of his pretensions the author, Prof. Wright, signed his name as a member of the United States Geological Survey, was especially offensive to the others who had been engaged under the auspices of the survey, whether as volunteers, professorial assistants, or permanent employees.

When Prof. Wright found his book thus attacked, he skillfully evaded the real issue—the truth or error of his conclusions—and he or certain of his personal friends raised the cry of persecution by the official geologists of the United States. Most of those who criticised him were professorial geologists, like himself, who had aided the Geological Survey with their work. Prof. Wright was thus attacking his fellow-workers in the field, not deigning to make scientific reply to scientific objections, but making only general statements in relation thereto, and turning the issue on the right of geologists to criticise his work, which he assumed was not official, though he had placed his name on his book with an official title.

All this required no reply from me, until at last Mr. Wright enlisted the championship of The Popular Science Monthly. An article by Mr. Claypole, of Ohio, was published in the April number of the journal, making a bitter attack upon the professorial geologists and upon the regular employees of the United States Geological Survey, and in no covert way attacking the administration of the survey itself. This attack, based as it was on error in every paragraph, would still have called for no response from myself, but would have been passed by, had not the editor of the journal attempted to draw a lesson therefrom in condemnation of the work of the Geological Survey and of that of the professorial geologists and volunteer assistants connected with the universities, colleges, and State surveys of the entire

* American Anthropologist, vol. ii, 1889, pp. 301–312.

country. It seems now to be incumbent upon me to make a simple explanation of the facts. This I have done briefly, with confidence that the editor of The Popular Science Monthly, finding that he has been misled in the matter, will cheerfully correct the impression that his editorial will naturally make upon those unacquainted with the circumstances.

For more than twenty years the writer of this article has been engaged in conducting and supervising scientific research in various portions of the United States. During the history of this work there have been published under his auspices about two hundred volumes, as annual reports, monographs, bulletins, and other miscellaneous works. In all this body of literature there is very little of controversy. The hundreds of men employed have worked together in practical harmony. They have not always agreed, but agreement has been singularly common, and when disagreements have arisen they have been stated courteously and with little exhibition of temper. It is believed that no other publications of the same magnitude can be found in the world where so little controversy is shown and where disagreement is so uniformly courteous. There have been some controversies, but they have been confined to the journals, and have not found their way into the official publications. And the journalistic controversies have been very few; and in only two instances within my knowledge have they been bitter, the case of this book being one of them. The controversy on this subject has not appeared in the official publications, but only in the journals. It has been wholly unofficial.

Prof. Wright stands almost alone in his advocacy of a scientific doctrine. He has a few sympathizers, and some defenders of portions of his theory, but the great body of his work is repudiated by nearly every geologist in America, and especially by the professorial corps. The controversy which broke out in the journals was at the time unknown to the Director of the Geological Survey. He was away from home and an invalid. He had never by word or circumstance directed or suggested it, and knew nothing of it until after it had occurred. Most of the gentlemen who engaged in it and expressed their indignation at what they believed to be a pseudo-scientific work, were connected with universities and colleges, and were wholly out of the jurisdiction of the Geological Survey. Nor are they men accustomed to brook such dictation. Only one of the controversialists was a permanent member of the Geological Survey.

After the above statement, it only remains for the editor of The Popular Science Monthly to render that judgment which the facts demand.

# MORAL LIFE OF THE JAPANESE.

By Dr. W. DELANO EASTLAKE.

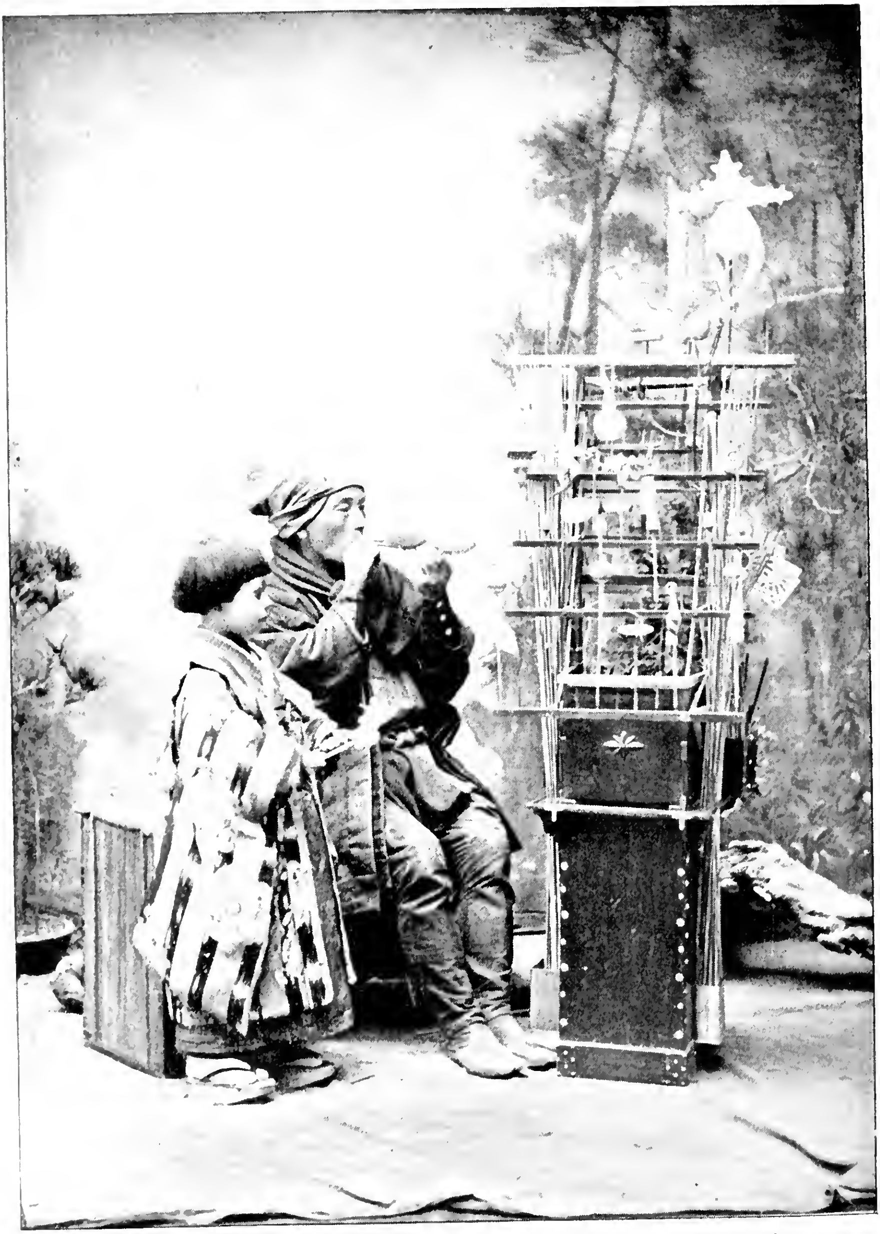
AMONG the many interesting features that a close acquaintance with Japan and its people reveals to foreigners, the ethics of the Japanese will surely claim the paramount attention of the ethnologist. The people are unlike any other; and we find that this strong national individuality—so fascinating to visitors to Japan—reaches far beyond the quaint homes, graceful costumes, obsequious courtesy of both rich and poor, and the picturesque beauty of the country itself; finding its origin in the very heart of the people, inculcated by the lives and precepts of generation upon generation of warriors, poets, and statesmen.

The moral life of the Japanese has found many exponents in the literature of the Occident, and, on account of the contradictory character of many of the writings on the subject, the ideas gained by the reading public can not be other than confusing and vague. Any just consideration of the ethics of the Japanese admits of no equivocation, and conventional prudery must in all cases be replaced by simple, ungarnished facts. I would neither seek to confirm nor deny the varied statements of other observers, believing that a clearer insight may be gained from a brief portrayal of the various ethical influences—either domestic, social, or religious—that touch the life of the people from early childhood until, after life is done, their mortal remains are packed into a square pine box, not unlike an ordinary dry-goods case, and consigned to the keeping of Mother Earth.

Japan has been frequently referred to as the "Children's Paradise," and with considerable justice, for in no other country is childhood made so much of, and are children surrounded by so many devices for their amusement. In every town there are numbers of street venders and hawkers whose sole customers are children. One class of these venders carry two charcoal stoves, or furnaces, swung in the conventional manner of the country from the ends of a pole which rests across the shoulder. Arriving at a convenient corner, the load is put down, and a group of eager children quickly gather. For the moderate sum of one or two *rin* * the children are each supplied with a tiny cup of sweetened batter and a spoon. Thus equipped, they proceed to bake their own cookies on the smooth iron top of the stoves, fashioning the dainties into whatever shape they please, and when they are crisp and brown, devouring them. The *amé* vender also devotes his skill to

* The Japanese rin is the tenth part of one sen, or cent; 1,000 rin, therefore, equal one yen, or dollar.

children. His "stock in trade" consists of dried reeds and a quantity of *midzu amé*, a sort of malt paste. Some of the *amé*



THE MIDZU-AMÉ ARTIST. An amuser of children, seen in every Japanese city.

is put on the end of a reed, and is molded or blown into some fantastic shape by the vender. The young customers dictate as to

the figures, and butterflies, flowers, gourds, or what not are shaped from the sweet paste. The children, after having satisfied their tastes for artistic design, eat the finished work, the reed handle preventing their fingers from becoming sticky. There is another of the child amusers that can be seen in the streets of Tōkyō or any other Japanese city. This artisan molds fruits, flowers, and

A Buddhist Priest in Full Canonicals.

vegetables from colored rice-flour dough, and does his work so deftly that it is really difficult to distinguish the artificial from the real fruit.

This universal love and regard for children is also displayed at every temple festival, where numerous booths, gay with toys, flags, and games, form always a prominent feature.

And what of the life of and influences surrounding these little folks? Well, the first event of importance after they have been ushered into this world occurs when they are one hundred days old. This is a feast day for the family, in which the baby plays the chief *rôle*. Toys, money, gowns, and sweets are lavished upon him by admiring friends and relatives. Among the poorer classes the baby is then considered old enough to be strapped on the back

of its brother or sister (usually the latter) and to go about with them during the greater part of the day, and from that time spend at least half the day in the open air. As soon as the child is old enough and strong enough to run about, a small doll-like bundle is strapped to its back, the weight of which is frequently increased as the child grows stronger; so, by the time the next arrival in the family has put in an appearance, a well-broken and docile little human "pack-horse" will be found ready for him. The newcomer is put through a similar course of training in due time; and so on, and so on—but let us trust not *ad infinitum!*

The relations between parents and children are entirely natural, free, and unrestrained. The truths of life and Nature are unfolded to them as soon as the children are old enough to inquire about them. Nothing is left for them to learn from outside sources. The result of this perfect candor, so far from developing any undue precocity in the children, serves to preserve that indefinable, unconscious grace, so beautiful in childhood, which, by the secret acquisition of some hidden knowledge, is so apt to be replaced by that glance of definable conscious disgrace seen in the faces of so many prematurely "old" children of the Occident.

There are two national children's festivals during the year: *Sekku*, for boys, and *Ohinasama*, for girls. *Sekku*, or "boys' day," is celebrated on the 5th of May. At this time gifts are made to the boys of the home, and for every male child in the family a huge paper carp (*koi*), of some brilliant hue, is hung out on a pole above the house-top. During this festival a Japanese town looks like a great aërial fish-pond. *Ohinasama*, "the honorable goddess of maidenhood," rules Japanese homes on the 3d of March, provided there are any daughters in the household. It is virtually "dolls' day," for all the dolls hold high carnival, and are brought forth with all their belongings—such as miniature ceremonial tea-sets, ornaments, and utensils—and set out in state; while in the *tokonoma*, or alcove, hangs a silken picture of Ohinasama herself; and a vase filled with odorous blossoms is placed before her. Presents to the daughters of the household, of flowers, cakes, and sweets, are also in order.

The school education of Japanese children begins at the age of six years; and in the primary departments the boys and girls are taught together, although occupying different parts of the school-room. It would be impossible, in this article, to discuss the present status of education in Japan; suffice it to say that there are business colleges, mining and engineering schools, law schools, universities, and even musical conservatories—all of which rank most high. Regarding the education of women, this usually consists in an eight years' grammar-school course, and frequently two or three additional years in the *shihan-gakko*, or normal school.

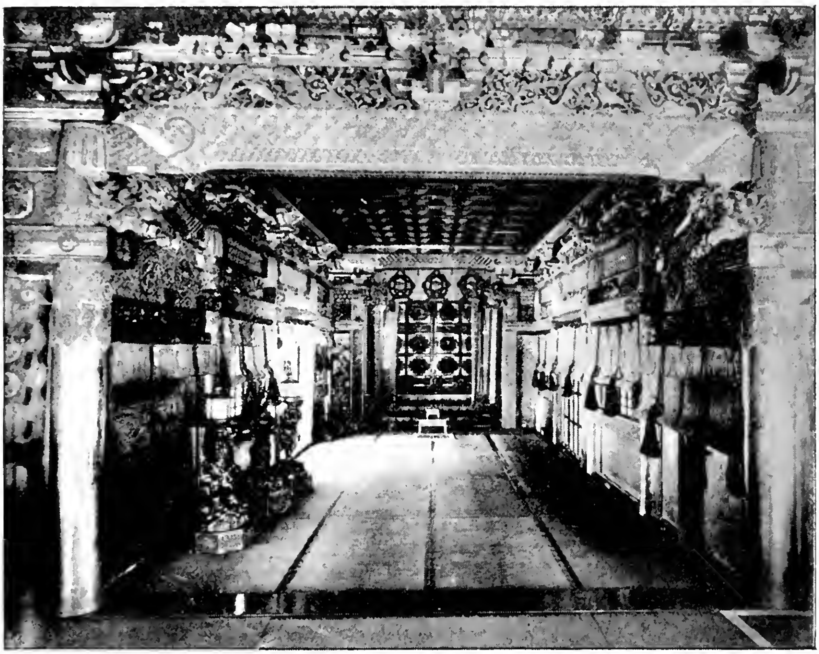
The moral education of Japanese children is conducted partly at home and partly in school, and is based largely upon the teachings of the history of the country. Intrepid valor, zeal, sobriety, directness of speech, extreme courtesy, implicit obedience to parents and superiors, and deferential reverence and regard for old age—

THE INNER GATE LEADING TO THE TOMB OF THE SHŌGUN TOKUGAWA, SHIBA, TOKYŌ.

these are among the chief characteristics looked for in boys; while industry, gentleness, faithfulness, and cheerful demeanor are required of girls.

Little or no importance is attached to the religious training of children. Whether the parents be Buddhists or Shintoists it

matters not, for in either case the children rarely take any part in the religious life of their parents or elders, and indeed usually grow up in blissful ignorance as to what it is all about. True, they may be occasionally taken to the temple, and taught to rub their palms together, clap thrice, and incline their heads toward the shrine, as they toss their offering of *rin* through the wooden grating of the huge money-till. They may have some vague notion that there is something meritorious in all this, but nothing more, although every Japanese home has a latticed niche, or *kamidana*, dedicated to the service of the household Lares and



Interior of the Shrine at the Tomb of the Tokugawa Shōguns at Shiba, Tōkyō.
Relics of the hero are preserved in the rear.

Penates, or *Daikoku* and *Ebisu* as they appear in Japan. These quaint figures—*Daikoku* with his bag of rice, and *Ebisu* with his wise smile and accompanying fish—are regarded more as symbols of good luck than supreme beings, and are retained, in many homes at least, in the same spirit as we Occidentals would fasten a horseshoe over a doorway.

The entire absence of demonstrative affection in Japanese families seems almost incompatible with the deep feeling of parental and filial love and tenderness that exists. Petting and caressing are dispensed with as soon as babyhood is over; and even during this time the mother but rarely presses her lips to the child's

A Chaya, or Tea House. Showing an interior similar to many Japanese homes.

face, although the ministering love and tender care of the parent are not lessened one whit with the advancing maturity of the child. Again, while the relationship between brothers and sisters is most sincere and cordial, embracing, kissing, or any other caress is never thought of. An old Japanese precept goes so far as to command that, after the age of seven, brothers and sisters should not even sit together; and up to the present dynasty this rule was strictly adhered to. So, when the father of the family would read aloud to the assembled children, the daughters would always sit apart, half hidden by a screen. In contradistinction to these apparently formal relations, brother or sister, even after having attained the age of puberty, will have no hesitation in disrobing or bathing before one another; while the utmost freedom in conversation is admissible. This formality between the sexes, even in the same family, may be briefly summed up in the words, "Hands off!" and apart from this the closest intimacy and affection may exist.

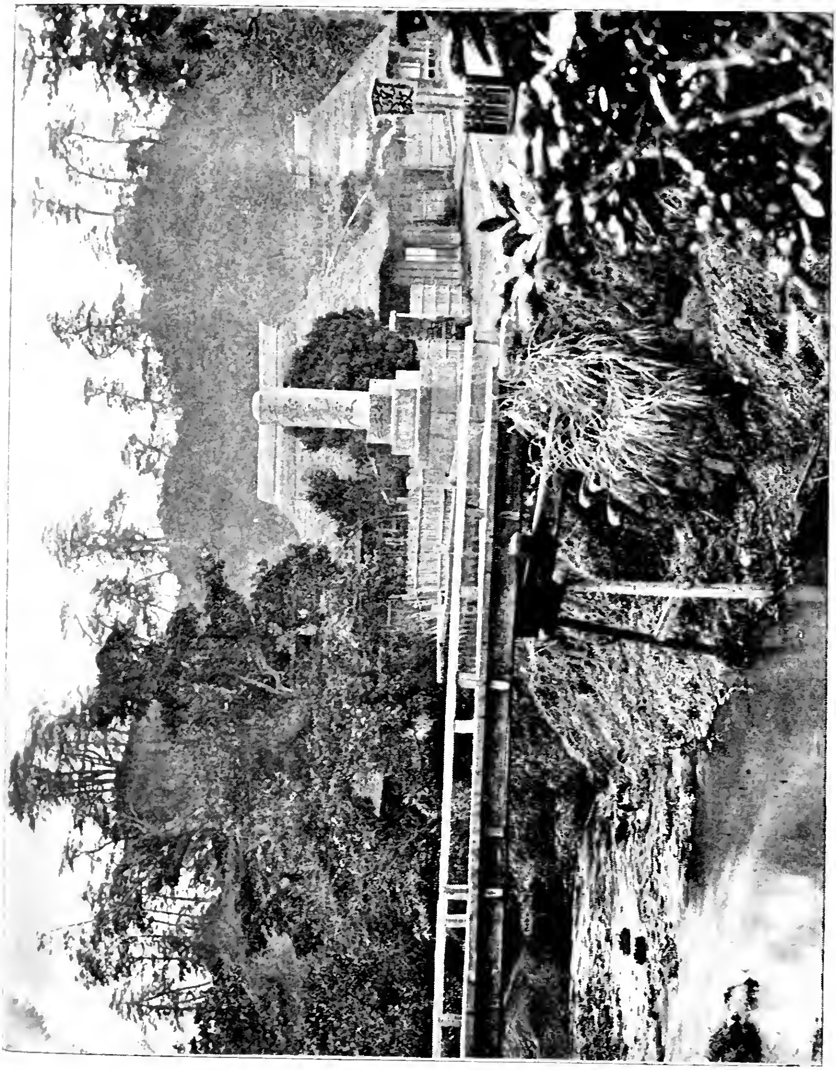
The word "kiss" finds no exact equivalent in the Japanese language: the nearest approach to it being *kuchi-su*, literally "to suck the mouth"—a caress only admissible in conjugal relations. The principal years of a girl's life that are specially celebrated are the third, seventh, and fifteenth, at which latter age she is regarded as a woman, and no longer a child. The most important years of a boy's life are the third, fifth, and fifteenth, and at this last age he is supposed to put off childishness, and is regarded as a man and of age. Besides the two children's festivals already referred to, there are four other minor boys' festivals and four girls' festivals in the year, so that practically every month has its "children's day."

So much for the ethics of child life in Japan; and much that has been said concerning the same holds good also during later years, in so far as the family relationships are concerned. We now can turn to a consideration of the various relationships between the sexes.

Engagements for marriage are either arranged by the parents of both families, while the principals are yet children, or else through the mediumship of a *nakodo*, or go-between, who must be a friend of both families. In the former case, it is usually with the desire of uniting the houses, and the engagement is arranged by the parents while the contracting parties are only infants; or even—conditionally, of course—before the birth of either child. The children thus engaged are brought up to regard each other as affianced, although their relationship toward each other is no more than playmate or friend, until the consummation of the marriage.

When a youth chooses a wife for himself, and has settled upon

his choice, he summons a mutual friend to act as *nakodo*. In this case the engagement is usually of very short duration; frequently not more than a few days or weeks. The *nakodo* arranges



The Hamlet and River of Kamari.

everything—the dower, the wedding itself, and the subsequent entertainment. The engaged couple may see each other, but never alone. Their previous acquaintance may have been a long one, and the young people themselves may have come to a mutual understanding: but to all intents and purposes the groom elect, prior to the betrothal, has merely been a friend of the family in general. The Occidental custom, or rather usage, which

Fuji-san, the Sacred Mountain of Japan, from Tango Lake. It is an inactive volcano, 12,365 feet above the sea.

permits the daughters of the home to entertain their male guests alone, would be regarded as unpardonable in Japan.

As I have said, the engagement is either the matter of a lifetime or else of a few days or weeks. The date of the wedding having been fixed upon, and finally arriving, the first step is taken by the ceremonious removal of the bride's effects to the home of the groom elect. Apart from a nominal civic marriage, which practically only consists in registration, the ceremony is purely of a domestic nature.

The wedding invariably takes place in the groom's house. The bride elect is escorted to her future home by her parents, and is received by a young girl, who acts as the *machi-joro*, "waiting lady," by whom she is conducted to the dressing-room. In the mean time the parents of both parties have assembled in the guests' chamber, with a few intimate friends and the inevitable *nakodo*. Before the *tokonoma*, or alcove, is a lacquered table, in the center of which is a miniature pine tree—the symbol of good fortune and prosperity; and beneath the tree are two miniature figures of an old man and woman, each with a broom—symbols of household thrift and long life; while at the root of the tree is an ancient turtle of bronze, also symbolic of longevity and good fortune. This odd ornament is known as the *takasago*, and is always placed between the bride and groom during the ceremony. There are also in readiness the *me-o-chocho* (male and female butterflies), a boy and a girl of about eight years old, who wait upon the bridal couple and take the place of our "best man" and "maid of honor." The *nakodo* is also present with a nest of three *saké* cups of different sizes, and a supply of hot *saké*, a rice spirit. The bride and groom having taken their places on either side of the *takasago*, the ceremony proper, or *san-san-ku-do*, or "three times three toasts," is next performed. The *nakodo* takes one of the cups and passes it to the groom. It is then filled with *saké* by the "best man," and then the groom drinks and returns the cup to the *nakodo*, who passes it to the bride. It is now filled by the "maid of honor" and emptied by the bride, and again returned *via* the *nakodo* to the groom, and again emptied. This same form is gone through with the two remaining cups, after which the couple are regarded as man and wife. Then the *nakodo*, or parent of the bride, chants the *takasago*, or nuptial ode, as follows:

"Takasagoya, kono ura buné ni,
Ho-o-ageté tsuki morotomo ni, ideshi-o no,
Nami no awaji no shima kageya,
To-oku naruo-no oki sugite,
Haya suminoye ni
Tsuki ni keri."

I will not attempt to render this in verse; approximately it may be Englished as follows:

> Takasago, ye married ones, have sailed now
> From the bay of lone estate,
> The moon of love has risen with the tide of joy
> And casts its silver beams upon the waters of your lives.
> The shadow of Awaji's Island steals across the rippling bay,
> And now the waters are all enshadowed, e'en to Suminoyé—
> Let peace and joy remain, for ye are one!

I have endeavored to ingraft the hidden meaning, or *imi*, into the above. Literally the ode would signify but little to us. The chant being finished, the few friends and relatives now offer their congratulations. In the evening there are a general reception and congratulations and good wishes all around. Among the merchant classes it is customary for the *nakodo* to take the bride around among her new neighbors the day after the wedding. The costume of both bride and groom at the wedding is ordinary "full dress," of a somber hue, but it must bear the family crest. Naturally, the details of marriage etiquette differ somewhat according to the social standing of the contracting parties, but the wedding itself always remains the same.

An interesting description of a sumptuous marriage and feast is contained in the following story, which also goes to show that the Japanese fox—that wary beast—also takes a keen interest in weddings:

### THE REVENGE OF THE FOX.*

About fifty years ago, when the Shōgun Tokugawa was at the head of the feudal chiefs, there was a prince in the province of Mikawa, whose prime minister was a man of great renown for his wisdom. This minister had lost his wife in the early years of wedlock, after the birth of a little daughter. The child grew to maidenhood, and often wandered far into the woods that surrounded the grounds adjoining the homestead, searching for wild flowers. The thousand sweet odors and the graceful blossoming plants filled her with intense enjoyment. One day she strolled deeper into the odorous shade of the thick forest than was her custom, and discovered a large hole, which she knew was the den of a fox. With childlike whim and thoughtlessness she began to throw little stones into the opening; but when the shadows of the great trees grew longer and longer, she suddenly remembered that the hour was late, and with a flutter of the heart hastened homeward to her father.

* Originally translated into German by F. Warrington Eastlake, Ph. D., and read before the Gesellschaft für Völkerkunde in Ost-Asien.

Full twelve months passed without any noteworthy occurrence. The minister's daughter grew more subtly beautiful day by day, and many noble lovers sought to win her favor. But the

BRONZE BELL IN UYENO PARK, TŌKYŌ.
About the bell are hung the straw sandals of devout pilgrims.

maiden's heart was not unlocked; her eyelids closed upon dreamless slumbers, and her gentle soul knew no dawning thought of love.

Then one morning came, when a gold-bedecked rider with a dazzling retinue drew up before the door of the mansion, and a

servant with low prostrations made known that the son of the prime minister of a neighboring prince had arrived. So soon as the handsome youth had dismounted, he was ceremoniously welcomed, and the cause of his visit inquired into. He answered that the fame of the young girl's beauty had reached his province, and he had hastened hither to ask for her hand in marriage. Greatly overjoyed, the proud father at once gave his consent, and ordered the attendants to summon his daughter; but the young knight interposed, saying that he must return without delay, and wished his bride to accompany him. With courteous mien he added that all necessary arrangements could be equally well carried out upon arriving at his father's house—such as the dower, wedding gifts, and everything relating to the marriage ceremony. No pomp or pageant would lack in fit magnificence by being postponed a little later, and the bride should be heralded by flowers, torches, and the marriage song; but their immediate departure was inevitable.

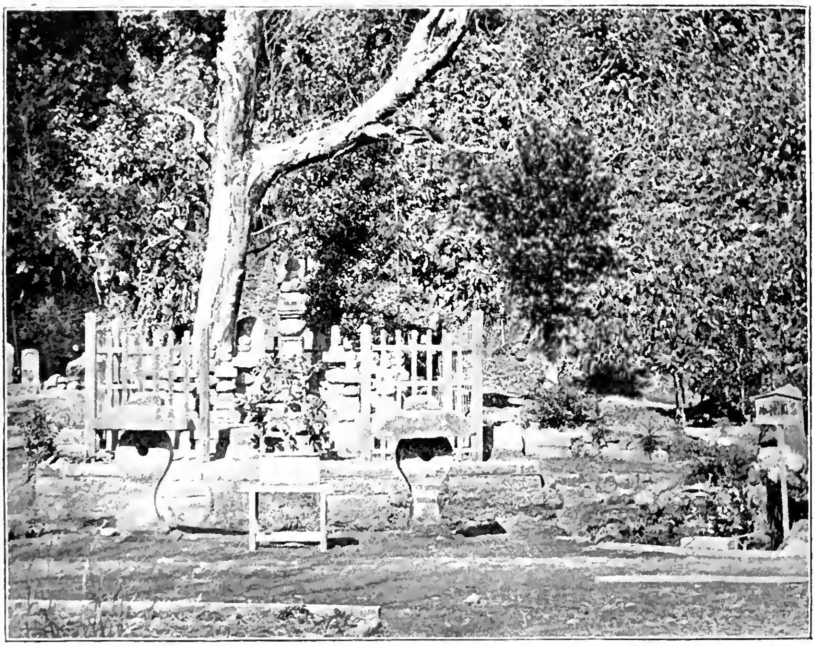
For a moment the lordly father was silent and embarrassed by doubts; but fearing that he might lose so brilliant a fortune for his only child, he gave his full consent. Within an hour the blushing girl, in bridal robes and splendid draperies, came through the outspread inner doors, and stood in all the "alarm of beauty and troubled pride," ready for the journey. Her waiting maids and servants, who were to accompany her, clustered around her, wondering whence sprang all this blaze of wealth in so short a space of time.

In a moment the *kago* (palanquin) for the bride was brought forth, and before she and her maids could realize the fact, the *kago*, the horsemen, and the courtly suite were in motion. This time the palanquins of the bride and retinue of women took the precedence and headed the rest, as with joyous music, and heralded by the blare of trumpets and roll of drums, the procession left the minister's door. It seemed not long before the bridal cavalcade drew up before a palatial building. The young groom sprang from his saddle, and, hastening to the *kago* of his bride, softly announced that this was his dwelling, and requested her to step out and enter the guest-chamber. She did so, while shadowy servitors bowed low within the halls as they entered. The bride said nothing, but opened her soft eyes half in fright, and then with wonder and admiration, at the beauty of the palace. Stately halls opened into still statelier chambers. Such unrivaled magnificence!—carved cedar, gold lacquer, and vessels of solid gold. In one fairy room, a mimic glade and shady forest with branching stems interlaced, recalled to her the woodland walks at home, while the very air seemed laden with the sweet odor of blossoms and wild flowers she used to gather.

Approach to the Temple at Nara.
On either side of the road are stone lanterns, the gifts of worshipers at the temple, and frequently memorials to the dead.

Upon reaching the largest room a regal feast was spread. Here, too, small woodland intricacies and miniature trees were in each nook and niche. The rich luster of the banquet-room, so filled with perfume and brilliancy, with mirrors on the walls, making twin pictures of all this loveliness, utterly bewildered the young bride. Then the groom reassuringly pressed her hand and told her that this feast had been prepared for her and her attendants. Happiness stole over her, and her rosy cheeks seemed to absorb the delight of her lover as he gazed upon her. Joy and gladness pervaded the guests, and the youthful bride tasted with delight the dainty dishes set before her.

Then, suddenly, a war cry resounded through the halls, and clearly could be heard the neighing of excited steeds and the



THE TOMB OF OGURIHANGUAN. A typical Japanese grave. The body is buried in a square casket, and is placed in a crouching position.

clash of drawn swords. The bride sprang up in terror, and her trembling maidens surrounded her as they beheld a full-armed knight, with threatening aspect, ride toward her. She turned quickly to her bridegrom for protection—but where was he? She shrieked, but nothing but the shriek and its echo were heard. Where was the gorgeous palace with all its new-born delights? All had vanished. The stately music and the soft-voiced lutes had ceased. A deadly silence, that seemed like a horrid presence, was all that remained. Bridegroom and friends, paintings and

carvings, vases and embroideries, palace and court were all gone. All was blighted. She and her maidens were standing in the middle of a shady recess in the woods; before her gaped only the dark opening of a fox's hole; and around them, instead of the splendors of the feast table, were refuse, offal, and all manner of offensive things. At this moment a horse and rider galloped up hurriedly beside them, and told the weeping maiden that he was the real son of the neighboring prime minister. He had heard that a deceiver had made use of his name, and had carried off the lovely daughter of the minister of Mikawa. He had come to find the wretch and avenge the dishonor, but had met no one but this little group of weeping girls in the wood.

Good counsel was dearly purchased. Heart-struck, the young bride, with weak hand, motioned him to be silent, for she knew now that she had been enchanted by the cruel fox, and that all that had occurred was a wizard's revenge. Sad and ashamed, with one beseeching glance, she turned away; and with her maids and servants entered her father's house again, and recounted all that had befallen her with browbeaten air, her fair form trembling with apprehension.

The minister was shocked and overcome with emotion, but carefully commanded that the affair should be kept a profound secret; as it was considered an entailed disgrace when a *samurai*, or high noble, or his children, allowed themselves to be bewitched by a fox.

Despite all warnings and every precaution on the part of his minister and his retainers, the rumor of the disgraceful enchantment reached the ears of the prince. He was terribly angry. "Surely, it must be a weak-minded fool," thought he, "who could so easily fall a victim to the intrigues of a fox," and he at once determined to banish the minister and his family from his kingdom. The honorable minister waited upon his princely master, and entreated a milder punishment, but without any success; leave he must with his daughter and servants. He journeyed to a distant province and died soon after, heartbroken by the disgrace. His daughter never married. It is true, her hand was sought by other men of rank, but she had had more than enough experience with her first bridegroom, and refused all others.

This was the revenge of the fox!

. . . . . . . . . .

The system of legalized concubinage, still existing in Japan, is far from being akin to polygamy in a social sense. In taking up this question, I am forcibly reminded of Pierre Loti's "Madame Chrysanthème." This story, while in many respects faulty in its portrayal of Japanese life, and at best revealing a rather degrading and unfortunate view, by no means typical except in seaport

towns where the foreign element is strong, nevertheless serves to reflect with considerable truth the attitude of so many—so very many—foreigners toward the women of Japan.

In Japanese households the concubine or *mekaké* occupies a position similar to that of a servant, so far as her rights are concerned. The wife is always the mistress of the house, and looks upon her husband's *mekaké* in the light of a maid. Should the concubine become a mother, she has no claim upon the child, who belongs to her master and mistress, and who is taught to regard them only as his natural parents. Indeed, most frequently a

The Great Temple Gate of Yengakuji.

*mekaké* is employed in a family for the sole purpose of securing an heir; and no sooner has the child been born and weaned, than the concubine is discharged.

The *mekaké* has no prerogatives above the other servants of the house, and is subject to immediate dismissal whenever the master of the house desires it. No pseudo-marriage, such as suggested by Pierre Loti, ever exists between the master of the house and the *mekaké*. She is simply a convenience, and has been secured from some employment bureau, just as any other servant, and receives regular wages.

Concubines are rarely, if ever, employed by unmarried men—at least among the Japanese; I do not refer to the foreign element—it being regarded as a grave breach of social laws. Where the *mekakés* mostly find a place is in the home of a long-married or childless couple. How does the wife tolerate the presence of the concubine? In the majority of cases, very well; for but few Japanese wives expect absolute loyalty on the part of their husbands.

THE DAI BUTSU AT KAMAKURA. This is the second largest figure of Buddha in Japan. It was formerly inclosed in a temple, but the latter was destroyed by an earthquake several centuries ago.

Although, as a rule, the husband remains true to his wife, he nevertheless is not bound to do so by any legal or moral obligation.

There have been several efforts made by reformers to discountenance the system of concubinage, and to make it illegal. But it would be decidedly a case of "people in glass houses," should the present Emperor of Japan enforce any such law, or allow it to be enacted. For not only is the Emperor himself the child of a *mekaké*, but so is also the present heir apparent to the throne.

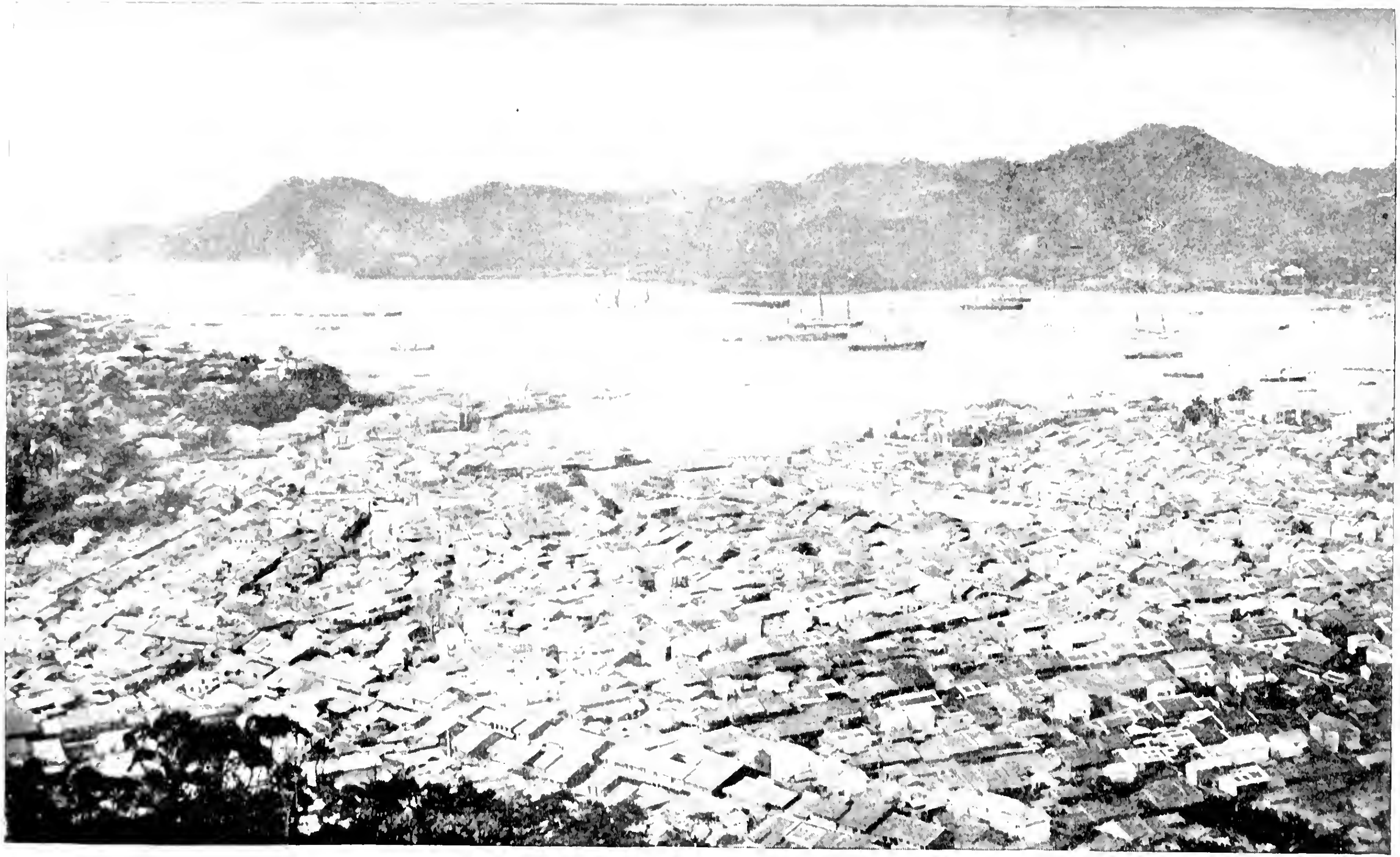
both the Empress Dowager and the present Empress being childless. Then, besides this, the Emperor's household includes several *mekakés* chosen from noble families.

Regarding divorces, up to the present time the husband has always had the privilege of divorcing his wife at will, and sending her back to her parents' home for apparently trivial reasons. But, as easy as it is to sever the nuptial bonds, this privilege is rarely taken advantage of, except in extreme cases, for divorces are looked upon with anything but tolerance by the Japanese. On the other hand, the only thing which warrants a wife in leaving her husband is cruel treatment, in which case she may return to her father's house, and the marriage may be annulled.

There are two other classes of Japanese women that I would make mention of: *geisha*, or professional entertainers, and *jōro*, or prostitutes. The *geisha* is a time-honored institution, and may be seen at almost any public dinner or entertainment. They are professional musicians, dancers, and entertainers in general, and are licensed as such. Frequently the *geisha* will take out a prostitute's license as well. From this it will be understood that what has been said concerning the reserved nature of social and domestic relationships in Japanese society is entirely absent with *geisha*. The women of the Japanese household rarely if ever take part in the public social life of their husbands, and therefore all social or official dinners among men are held at some restaurant or tea-house, and *geishas* employed to furnish music and entertainment. They frequently are accompanied by two or three dancers (*oshakku*), girls between twelve and fifteen years of age, who dance while the *geishas* furnish music and song. The moral instincts of the *geisha* are crude, to say the least, and many progressive Japanese look eagerly forward to the day when the *geisha* will not be an inevitable feature of entertainments.

Prostitution is under strict government control and supervision, and all houses of ill fame relegated to certain portions of the town known as the *yoshiwara*. A prostitute's license is only for three years, for which period of time she sells herself to the keeper of one of these houses for a lump sum. Not infrequently among the poorer families, one of the daughters of the home is thus practically sold to a life of dishonor by her parents, in order to keep the wolf from the door. I know of many sad cases of this kind; and while this heartless procedure is legal, yet it is regarded with equal repugnance and abhorrence by the Japanese public as it would be with us, and is as loudly condemned. After the three years' service is over, the daughter may again return to the parental roof.

Regarding the moral life of women of the poorer classes, it is in the main similar to that of the higher. The maids employed



The Harbor of Nagasaki. The town is the most southern of the Japanese treaty ports.

by the second-rate hotels and tea-houses bother themselves but little about any moral obligation; but, on the whole, the immorality laid at the door of Japanese women is unjust and misleading.

Regarding the religious life of women as affecting the ethics of the country, little remains to be said. The enamored maiden may write the name of her lover and herself on two strips of paper, and, twisting them together, tie the spell to the lattice work of the temple of *Kwannon*, the goddess of love, trusting that her offering and prayers may be of avail, and unite their lives and hearts.

Religion enters mostly into the lives of the Japanese people when the sands of life are nearly run out. It is then that the people, and more especially the old women, turn to Buddhism or Shintoism with great avidity, and if wealthy will make lavish gifts to the temples, or cause votive stone lanterns to be erected at their expense along the approach to the temples, and will readily yield themselves to the commands of the astute priests, so that they may be assured of future peace and happiness. The Buddhist faith undoubtedly offers the greatest inducements to believers and condemnation to heretics. The Shinto faith, which is the present court religion, is practically a hero worship, and the Shinto priests are not celibates. Some of the more popular saints or deities have been adopted by both creeds—as a matter of policy—notably the "Seven Wise Ones," *Sichi Fuku Jin*, among whom are Daikoku and Ebisu, the household Lares and Penates. In the Shinto temples there are no idols, but relics of the deified hero are preserved; and before the shrine stands a huge mirror of polished metal, into which the worshiper gazes, seeking to place himself face to face with his own soul. In the Buddhist temples there are idols and superstitions galore.

Such are briefly the most salient features of the ethics of the Japanese, in the account of which I have unavoidably been compelled to omit much that is interesting and novel. As I have said, on the whole the Japanese people have been done a great injustice to, when a lack of moral instinct has been charged to them. In no other country, and surely in no other language, has love found an apter exponent. Filial piety, connubial affection, parental tenderness, fraternal fondness—all these have been sung about in Japanese poetry in a thousand dainty ways, and may be daily witnessed in the lives of the people, and above all this is that ardent spirit of patriotism and love for home that so preserves the unity of the Japanese people; and should we seek for the keynote of the wondrous ancient heroism and present rapid advance of the country we will surely find it in the words *Mikune no tame*, "For my country's sake."

# EDUCATION AND SELECTION.

By M. ALFRED FOUILLÉE.

MOST of the controversies which are rife in reference to the vital question of education appear to have originated in failure to rise to a sufficiently general point of view of the subject —to a national, international or perhaps an ethnic view. M. M. Guyau, who, in his *Education et l'Hérédité,* has discussed problems relative to morals, religion, æsthetics, and education, from the sociological point of view, has put the question into a really scientific form: Given the hereditary merits and faults of a race, to what extent can we by education modify the existing heritage to the advantage of a new heritage? For nothing less is involved; we have not only individuals to instruct, but a race to preserve and increase. Education, therefore, must rest on the physiological and moral laws of the cultivation of races. We do not overlook this in breeding useful animals, but in dealing with human beings we forget it—as if the education of men was concerned only with individuals.

The ethnic point of view is the correct one. We need, by education, to create hereditary qualities physically and intellectually useful to the race; besides cerebral and physiological heredity, we should assure such social hereditary forms as traditions, customs, social conscience, and public opinion. Society is, in fact, an organism endowed with a certain collective consciousness, although it is not concentrated in a self. We should, therefore, regard as a form of heredity and organic identity through ages, everything that maintains among a people continuity of character, spirit, habits, and aptitudes: in short, a national consciousness and a national will.

It being admitted that the ultimate aim of education is to insure the development of the race, the question arises as to the best means of insuring it. There is one which we desire to set prominently in the light—selection. The history of mankind shows us the struggles of races, nationalities, and individuals—not for life only, but for the progress of life under all its forms, including intellectual, æsthetic, and moral life. In our talk about the struggle for existence we forget the metamorphosis which selection undergoes in passing from the domain of brutal into that of intellectual and moral forces. We have, therefore, to reach a comprehension of the analogies and the differences between natural and social selection. As a first step toward this, we should ask to what extent ideas rule the world, and how a selection of ideas is first induced in the brain by education. We might call this psychological selection. The power of instruction and education,

which some exaggerate and others deny, is simply the force of ideas and feelings. We can not bring too much scientific exactness to the determination of the extent and limitations of this force. We start from the principle that every idea tends to realize itself; and it does so in fact, if it is not counterbalanced by a superior force. The principle of the struggle for existence and of selection is applicable, therefore, to ideas not less than to living individuals and species. A selection is produced in the brain in favor of the strongest and most exclusive idea, which carries the whole organism. The child's brain is a battlefield of ideas and the impulses they generate; every new idea is an additional force encountering ideas already installed and impulses already developed. Education is, then, a work of intellectual selection. Let us suppose a mind still void, into which is abruptly introduced the representation of movement, the idea of some action, as of raising the arm. The idea being solitary and without any counterpoise, the disturbance begun in the brain takes the direction of the arm, because the nerves abutting in the arm have been disturbed by the representation of it; consequently the arm rises. To think of a movement is to begin it. A movement once existing can not be lost, but is communicated as of necessity from the brain to the organs—unless it is arrested by some other representation or impulsion. This propagation of motion is assured physiologically by the symmetry of the limbs, which tend to execute the same movement in succession. The brain provides the theme and the limbs reproduce it, and we have sympathy and synergy of the organs. The contagion of the idea to the limbs is infallible if the idea is solitary or predominant. We call this the law of idea-forces.

Chevreul's well-known experiments with the exploratory pendulum and the divining rod show that, if we represent to ourselves a motion in any direction, the hand will unconsciously realize it and communicate it to the pendulum. The tipping table realizes a movement we are anticipating, through the intervention of a real movement of the hands, of which we are not conscious. Mind-reading, by those who divine by taking your hand where you have hidden anything, is a reading of imperceptible motions by which your thought is translated without your being conscious of them. In cases of fascination and vertigo, which are more visible among children than among adults, a movement is begun the suspension of which is prevented by a paralysis of the will, and it carries us on to suffering and death. When a child, I was navigating a plank on the river without a thought that I might fall. All at once the idea came like a diverging force, projecting itself across the rectilinear thought which had alone previously directed my action. It was as if an invisible arm

seized me and drew me down. I cried out, and continued staggering over the whirling waters, till help came to me. The mere thought of vertigo provoked it. The board lying on the ground suggests no thought of a fall when you walk over it; but when it is over a precipice and the eye takes the measure of the distance to the bottom, the representation of a falling motion becomes intense, and the impulse to fall correspondingly so. Even if you are safe, there may still be what is called the attraction of the abyss. The vision of the gulf as a fixed idea, having produced an "inhibition" on all your ideas and forces, nothing is left but the figure of the great hole, with the intoxication of the rapid movement that begins in your brain and tends to turn the scales of the mental balance. Temptation, which is continual in children because everything is new to them, is nothing else than the force of an idea and the motive impulse that accompanies it.

The force of an idea is greater as the thought is more distinctly selected than others in the consciousness. This selection of an idea that becomes so exclusive that the whole consciousness is absorbed in it has been called monideism. The state is like that of a hypnotized person. The hypnotizer creates an intellectual void in the brain by inducing artificial sleep, and suggests a thought which, being alone and unhampered, is at once realized in movements; and hypnotic suggestion is nothing else than this artificial selection of a single idea to the exclusion of others. The same force of the idea prevails in natural somnambulism. The somnambulist no sooner thinks of anything than he performs it, with his hands and feet as well as with his brain. The movement of the overexcited brain is so lively and the resistance offered by the sleeping organs is so weak that the impulse is communicated to the limbs by the mere fact that it has been conceived. The kind of dream in which children sometimes live is not without some analogy with somnambulism. The fixed idea is another example of the same phenomenon which is produced in the waking state, and increasing may go on to monomania—a kind of unhealthy monideism. Children, having few thoughts, would be likely to have fixed ones, except for the mobility which perpetual novelty causes in them. In this way all the facts may be explained that are grouped under the name of auto-suggestion. Generalizing the law, we might say that every conceived idea is an auto-suggestion, the suggestive effect of which is counterbalanced only by other ideas producing a different auto-suggestion. This fact is especially exemplified in children, who execute very quickly what passes in their heads.

The force of example is likewise brought back to the communicative and selective force of all representation. In the same manner is explained the form of suggestion in which the idea

suggesting the act occurs not to one's self, but is introduced by another. In this line M. Guyau has pointed out a possible application of suggestion in moral therapeutics "as a corrective of abnormal instincts or as a stimulant of too weak normal instincts." He looks upon suggestion as an instinct in the nascent state created by the hypnotizer. Many and important results have been realized from suggestion since his remark was made. Of course, M. Guyau does not advise, but expressly condemns the introduction of hypnotism into normal education. He cites these pathological facts in order to deduce from them consequences relative to the normal condition. He considers hypnotic suggestion as simply the unhealthy and grossly artificial exaggeration of suggestive phenomena which are produced in a state of perfect health. Normal suggestion, which alone should find a place in education, is psychological, moral, and social; it consists in the transmission of ideas or impulsive feelings from one person to another, and in the possibility of fixing them. While in the normal condition we are not under the power of a determined magnetizer, it does not follow that we are not "accessible to an infinity of little suggestions; now acting contrary to one another, now acting cumulatively and producing a very sensible average effect." Children in particular are open to all the suggestions of the medium. The state of an infant on coming into the world is compared by M. Guyau to that of a hypnotized person. There is the same absence of thoughts of its own or the same predominance of a single thought. "Everything that the infant will hear or see will therefore be a suggestion. This suggestion may be the foundation of a habit which may be developing during the child's whole life, as impressions of terror inculcated in children by nurses often do." If the introduction of new feelings is possible by a wholly physiological means, it should be equally possible by psychological and moral means.

Suggestion, which creates artificial instincts capable of balancing hereditary instincts, constitutes a new power comparable with heredity. Education, says M. Guyau, being a collection of co-ordinated and reasoned suggestions, we can understand the importance, the efficiency which it may acquire in both a psychological and a physiological respect. In our own view, suggestion is only a particular instance of the more fundamental law of idea-forces which rules in all pedagogic science.

Ideas have been sometimes despised and treated as having hardly any influence on the conduct. The philosophers of the eighteenth century, with Descartes and Pascal, on the contrary, regarded the feelings and passions as confused thoughts, as "precipitations" of thoughts. There is truth in this. Under all our feelings there is a collection of imperfectly analyzed ideas, a flood

of hasty and confused reasons, on the mass of which we are lifted up and borne off. On the other hand, there are feelings under all our ideas which breed even under the cooling cinders of abstractions. The mind itself has a force, because it arouses all the feelings which it summarizes. Thus the simple words "honor" and "duty" resound through our consciousness in infinite echoes, giving rise to legions of images.

We talk of dead formulas, but they are few. The idea and the word are formulas of possible actions and of feelings ready to pass into acts; they are "verbs." Every feeling, every impulse that comes to the point of formulating itself into a kind of fiat, acquires by that fact a new and in some sort creative force. It finds itself cleared up, defined, specified, and squared with the rest, and thus directed. It is this that renders formulas relating to actions powerful for good or evil. A child has a vague temptation, an inclination he can not account for. Pronounce the formula to him, change the blind impulse into a clear idea, and you give him a new suggestion, which will, perhaps, cause him to fall on the side to which he is inclining. On the other hand, there are formulas and generous suggestions that need only to be pronounced to carry entire masses. It sometimes falls to the man of genius to translate the aspirations of his epoch into ideas; he pronounces the word and a whole people follow. Great moral, religious, and social revolutions occur when feelings, long restrained or hardly recognized, come to be formulated into ideas or words. The way is then opened, the object is revealed with the means, selection takes place, and all the desires are turned at once in the same direction, like a torrent that finds a point where passage is possible.

Conduct depends, therefore, to a large extent on the circle of the ideas which one has received under the influence of experience, social relations, and æsthetic and intellectual cultivation. Every man possesses at the bottom a collection of general notions and maxims which becomes the source of his resolutions and actions, because the aggregate is fused into a sentiment and a habit. The tendency to translate everything into maxims is manifested even in children, because the maxim is a generalization that satisfies the thought. If, then, the circle of ideas proves incomplete at any important point, if false notions or immoral maxims insinuate themselves, we are condemned to incurable weakness or to vice, like a nation whose code contains bad fundamental laws.

The mental faculties, like the physical faculties, develop in the individual into a relation of reciprocal action; but mental activity is more dependent than the other. If you have false ideas on a point of fact or reasoning, it is possible for me in a little while to

enable you to put your finger on your error, or by a demonstration to convince you of it. But it will take months or years to modify a feeling, an inclination, or a habit. Intelligence is, therefore, more flexible, more movable, more progressive, than the rest of our constitution, and for that reason we can act upon it with more facility. Put over the eye of a near-sighted man glasses that will make things visible to him, and he will be obliged to agree that he sees them; show an ignorant man a drop of water in the microscopic field, and he will have to recognize that it is inhabited. Intelligence is to the other faculties of our mind what the eyes are to the organs of our body—a touch at a distance. Hence intellectual activity has a superior power to direct and transform the other kinds of activity. As it discovers new sides in things, it thereby produces a double effect. It excites new feelings and opens new ways to action. Every new idea tends thus to become a sentiment and an impulse, and consequently an idea-force. The intelligence is the great instrument of voluntary selection. It is a shortening means of evolution; it accelerates and accomplishes in a few years selections that might otherwise have required centuries.

If, instead of the individual, we regard the social organism, we shall find that here, too, the diverse activities and the diverse products of civilization are conditioned upon one another, while the products of intelligence and knowledge stimulate or direct all the social functions. Religious, moral, æsthetic, political, and economical creations are determined by the progress made by mankind, whether in the real knowledge of things or in the discovery of new ideals. Instruction is a motor of prime importance in the social mechanism; but on condition that it is brought to bear on truly directive and selective ideas, on those which, by their intimate relation with feeling and will, conspicuously merit the name of idea-forces.

There is, therefore, a medium between prepossessions for and against education. If education does not manifest all the power of which it is capable, it is because it is rarely directed toward its true end and by means adapted to that end. From this results a loss of living forces by the mutual neutralization and disorder of ideas. We sow ideas, as it were, at haphazard in the mind. They germinate in like manner according to the chances of circumstances, of internal predispositions and of the external medium. This is fortuitous selection, as in the domain of material forces. It is not sufficient to instruct; instruction itself must become an education, a process of reflected and methodical selection between ideas that tend to assume reality in acts. We say continually, instruction; other peoples say cultivation, and they are right. The former word leads us to consider the material bearing of what is acquired; the latter the degree of fertility gained by the mind.

Education should not be a simple acquisition of knowledge, but a cultivation of living powers for the purpose of assuring the preference of the highest idea-forces.

After psychological selection, internal to the individual, we have to consider social selection, which takes place between different individuals, or between races or peoples. There are, for any race, physiological and psychological essential conditions of superiority. The race must first of all be physiologically strong, and here only are the ordinary laws of selection applicable, because we are in the domain of life. The sound mind can not exist except in the sound body; all the delicacies of mind are not worth as much to a race as health, vigor, and fertility. Even geniuses can not be born except of a strong race; the intellectual faculties can not be kept up long and advance, except among a vigorous people, and selection can not be efficient and produce the best by nature—a necessary condition of all progress—except in a fruitful and numerous and consequently strong race. Whenever, therefore, we overwork the mind at the expense of the body, we lower the physiological, and therefore the intellectual, level of the race; for generations physiologically weakened will sooner or later suffer the weakening, with their cerebral power, of their mental capacity. The laws of heredity are fatal: to bequeath impoverished organs to children is to prepare for what Pascal would call the stultification of the race at a more or less distant epoch. In the struggle and selection of peoples as recorded in history, when young and perhaps barbarian blood has not been infused with the aged body of a nation, it has fallen steadily, become sterilized, and disappeared or declined, while other peoples were ascending.

Instruction may, we think, lead to two kinds of results: either in dynamic effects—that is, augmentation of cerebral force—or in purely mechanical effects; like scientific and literary routine. In the former case, it acts upon heredity and can produce a hereditary transmission of cerebral force; in the second case, it does not act, or it acts mischievously to the exhaustion of the nervous system. It is intellectual force, not acquired knowledge, that is transmitted by heredity from one generation to another. Hence the criterion which we propose for estimating methods of education and teaching; if there is an augmentation of mental, moral, and æsthetic force, the method is good; if a simple storing up in the memory, the method is bad, for the brain is not a storehouse to be filled, but an organ to be fortified.

The physical and mental inconveniences of overwork may, therefore, very properly occupy attention at this time. Good scholars—those who wish to succeed in an examination or enter certain schools—are the ones who are overworked under our present systems; for the majority of pupils there is no overwork, but

simply almost complete loss of time, years passed in wearing out the benches of the school. Of all that is paraded before their minds they retain nothing but a few vague and confused notions; they attend, as idlers, the excursions of their successive professors through all kinds of sciences, and what is overwork for the others is for them only intellectual vagabondage. If all children were overworked, the race would soon be lost. The idle, says M. Guyau, save it physically. On the other hand, unfortunately, they contribute to keep it in intellectual and moral mediocrity, and to give a false direction to public affairs. The advantages of their idleness might have been preserved without suffering its inconveniences if instead of requiring from all so much knowledge, most of which is useless, we had required strictly necessary knowledge and such moderate number of the finer branches as would lift up the mind while interesting it. In this way we could suppress a large number of the idlers without falling into overwork and without depreciating the race under pretense of elevating it. We need not concern ourselves about the number of things a child knows, but about the way he knows and has learned them, and about the general vigor he derives from his exercises, which alone gives a net profit to the species. How does the earth recreate itself? In the sun, the air, and the rain, by the free action of forces which work upon it incessantly. Quiet on the surface, it works and buds beneath. So with the mind. We should at certain times let Nature act, and not interrupt the unconscious and spontaneous work of organization that is going on in the depth of the brain, as we let the force which is germinating grass and oaks work in the depth of the soil, in solitude.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

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Prof. W. Flinders Petrie is quoted as having said that the Egypt of the early monuments was a mere strip a few miles wide of green, amid boundless deserts, and beneath a sky of the greatest brilliancy; a land of extreme contrasts of light and shadow, of life and death. These conditions were reflected in the art. On the one hand was the most massive and overwhelming construction, and on the other, the most delicate and detailed reliefs; on the one hand, the most sublime and solid statuary; on the other, the course and accidents of daily life freely treated; on the one hand, masses of smooth buildings that far outdo the native hills on which they stand, gaunt and bare; and on the other, the vivid and rich coloring in the interiors. In consequence of the climate also Egypt is a land of great simplicity of life, and simplicity is the characteristic of the oldest Egyptian buildings.

From the ages of persons who have died in France during the last thirty-two years, M. Turquan computes that the average length of life in that country has been about thirty-eight years for women, thirty-six years for men, and thirty-seven years for the whole. This is now exceeded, and the average has risen to more than forty years.

# EVIL SPIRITS.

By J. H. Long.

OF all the dark chapters in the history of the world none is more terrible than that which deals with sorcery and demoniacal possession. To-day this belief has almost entirely disappeared in civilized lands: it lingers only in some remote hamlet in "lucky and unlucky days," good and bad signs, and similar harmless idiosyncrasies; although most grown persons can remember that in their childhood certain uncanny individuals were regarded as "witches," just as certain houses were said to be "haunted." But, after all, the belief was only vague and nebulous; while now among even the children ghosts and fairies and witches are regarded with profound skepticism. It is extremely difficult, then, for us to grasp the idea that "for fifteen hundred years it was universally believed that the Bible established in the clearest manner the reality of witchcraft, and that an amount of evidence so varied and so ample as to preclude every possibility of doubt attested its continuance and prevalence. The clergy denounced it with all the emphasis of authority. The legislators of almost every land enacted laws for its punishment. Acute judges, whose lives were spent in sifting evidence, investigated the question on countless occasions, and (as a result) condemned the accused. Nations that were completely separated by position, by interest, by character, were united on this question." More than this. In the city of Trèves alone seven thousand witches were burned. At Toulouse, the seat of the Inquisition, four hundred persons perished in one single execution. Rémy, the judge of Nancy, in France, boasted that he had put to death eight hundred witches. In the little Italian district of Como one thousand perished in one year. The Judge Voss of Fulda burned seven hundred, and said that he hoped to make it one thousand. Benedict Karpzow boasted that he had signed twenty thousand death-warrants for witchcraft. In Sweden in 1690 seventy persons were condemned, and most of them burned. In Great Britain, chiefly in Scotland, in twenty years alone between three and four thousand were put to death. The executions in Paris in a few months were, a contemporary writer says, "almost infinite." Indeed, not to mention imprisonment and torture—torture beyond the wildest flight of modern fancy—the number of persons who perished, chiefly by fire, in Christian Europe and America has been calculated as from one million to nine million. Probably four million is a correct estimate. The annals of the world may be searched through and through, and nothing can be found, I believe, to compare in tragic interest with the chapter on witch-

craft and sorcery. It seems a dreadful thing to say, but I believe it is true: all the heathen persecutions of Christians put together are nothing in comparison with the horrors of the crusade against witches set on foot by members of the Christian Church and by civil rulers in sympathy therewith.

Nor is any single church entirely exempt from this charge. "The Roman Church proclaimed in every way in her power the reality and the continued existence of the crime. She taught, by all her organs, that to spare a witch was a direct insult to the Almighty; and to her ceaseless exertions is to be attributed by far the greatest part of the blood that was shed." Bulls were issued by Pope Innocent VIII, who commissioned the inquisitor Sprenger, whose book was long the standard authority on witchcraft, and who (Sprenger) condemned to death hundreds every year. Bulls were issued also by Pope John II, by Adrian VI, and by many another occupant of the chair of St. Peter. "The universal practice was at service to declare magicians and sorcerers to be excommunicated, and a form of exorcism was inserted in the ritual of the church. . . . Ecclesiastical tribunals condemned thousands to death; and countless bishops exerted all their influence to multiply the victims." The same was the case—although not to so great an extent—with the non-Roman churches. Luther said: "I would have no compassion on these witches: I would burn them all." In England the Reformation was marked by a large increase in the number of persecutions; the prominent theologians, both within and without the established Church, holding firmly to the belief in witchcraft. In Scotland persecution was carried on with peculiar atrocity, while the executions in Puritan Massachusetts form one of the darkest pages in the history of America.

Now, the remarkable thing about witchcraft is that it was believed in not only by the ignorant, but also by the learned; not only by the clergy, but also by the laity. "The defenders of the belief maintained that no historical fact was more clearly attested. . . . The subject was examined in every European land by tribunals which included the acutest lawyers and ecclesiastics of the age, on the scene and at the time of the alleged acts, and with the assistance of innumerable sworn witnesses. The judges had no motive whatever to desire the condemnation of the accused; indeed, they generally had the strongest motive to proceed with caution and deliberation," in view of the awful penalties attached to conviction. Cudworth, one of the most learned theologians the Anglican Church has ever produced; Bacon, one of the acutest lawyers and philosophers of the age; Sir Matthew Hale, chief justice toward the end of the seventeenth century—these are only three from a host of names that might be cited of those who believed in

witchcraft. Sir Matthew Hale lays it down in one of his rulings that it is an undoubted fact that there is such a thing as witchcraft, and that witches ought to be punished. Even Shakespeare shared in the general belief; the witches in Macbeth were to him, not poetic creations, stern realities.

The question is, then: How did this marvelous delusion arise? Three causes, I believe, produced it. 1. To quote Lecky, the historian: "A religion that rests largely on terrorism will engender the belief in witches or magic; for the panic which its teachings create overbalances the faculties of the multitude." This is true: a cruel religion, as Christianity became when it began to rest more and more on the basis of eternal punishment and the wrath of God, will inevitably be haunted by the fear of evil spirits. Therefore it is that the religion of Zoroaster and that of Brahma have been free from the reproach of the persecution of witches and sorcerers. 2. The support from the Bible. Now, there is no doubt at all that the Bible does support the doctrine of evil spirits and witchcraft. And this fact alone is sufficient to destroy the orthodox theory of what Dr. Briggs calls "biblical inerrancy," or freedom from error, for not one person out of one hundred now believes in the reality of possession by evil spirits. There is, I say, no doubt that the Bible does teach this doctrine. "Thou shalt not suffer a witch to live," was the repeated command in the Levitical law; this command was the foundation stone upon which the putting to death of witches rested. We all know the story of the witch of Endor, as told in the twenty-eighth chapter of the First Book of Samuel. Again, the devil afflicted Job in various ways, one way being the sending of a tempest which destroyed Job's sons. Great atmospheric disturbances were always ascribed to Satanic agency, although a nice distinction prevailed: when the destruction was great, it was ascribed directly to Satan; when small, to angels, the word angels being used in a double sense, as messengers of evil and messengers of good. To come to the New Testament. Philip baptizes Simon the sorcerer; and Saul of Tarsus finds in Paphos a certain sorcerer, a false phophet, a Jew named Bar-Jesus.

Whatever view we may take of the Bible, one thing is certain, it abounds with references to evil spirits, the Bible characters believed implicitly in the existence of such spirits, and there is no intimation given that the reign of such evil spirits should cease to exist until the end of all things. We are expressly told, indeed, that "when Christ had called unto him his disciples, he gave them power against unclean spirits to cast them out"; and again: "And these signs shall follow them that believe: in my name shall they cast out devils."

The third cause of the growth of this delusion, and the most

important of all, was the belief that natural phenomena of a hurtful type are the result of the action of evil spirits. As a writer has said: "The phenomena which impress themselves most firmly on the mind of the savage are not those which are manifestly the operation of natural laws and which are productive of beneficial effects. They are, on the contrary, those results which are disastrous and apparently abnormal. Gratitude is less vivid than fear, and the smallest apparent infraction of a natural law produces a deeper impression than the most sublime of its ordinary operations. When, therefore, the more startling and terrible aspects of Nature are presented to his mind, when the more deadly forms of disease or natural convulsion desolate his land, the savage derives from these things an intensely realized perception of diabolical presence. In the darkness of the night, amid the yawning chasms and the wild echoes of the mountain gorge, under the blaze of the comet or the solemn gloom of the eclipse, when famine has blasted his land, when the earthquake and the pestilence have slaughtered their thousands, in every form of disease which refracts and distorts the reason, in all that is strange, portentous, and deadly, he feels and cowers before the supernatural. Completely exposed to all the influences of Nature, and completely ignorant of the chain of sequence that unites its various parts, he lives in continual dread of what he deems the direct and isolated acts of evil spirits."

These three causes, then, combined to produce a belief in witchcraft and Satanic possession.

Let us now trace its growth as far as Christianity is concerned. But to understand this we must go back for a moment to the classic nations among whom Christianity was planted. Magic or sorcery prevailed among the Greeks and Romans, all sects accepting its existence except one sect, that of the Epicureans. It is true, occasional laws were enacted against its practice; in some instances magicians were condemned to death; but the persecution in general was only occasional and was not severe, as magic was regarded as an offense not against God or the gods, but as against the state or the individual. The magician was punished because he injured man, not God. And punishments for injuries to men have always been less severe than punishments for supposed injuries to God. This is the rule of history: punishments for religious offenses have been much greater than those for civil or criminal offenses, the greatness of the crime being measured by the greatness of the being injured. At times it was found that the prognostications of the soothsayers from the flight of birds, the positions of the stars, and other data, tended to produce conspiracies against the emperor; and so punishments were inflicted and repressive laws passed. But, in general, magic and soothsaying

were not regarded with disfavor, the augur, the *haruspex,* and the keeper of the sibyl's books being considered as part of the regular state life of Greece and Rome.

With the advent of Christianity, however, there came a great change. In the matter which we are considering, as in many another, old things had passed away and all things had become new. Before very long after the death of Jesus the Christians were filled with a sense of the awful presence—in fact, the omnipresence—of Satan, which colored their every thought and act. This, added to the idea of eternal punishment—a fate reserved for all those about them who were not of the new faith—gave to the early Christians an intensely realistic sense of evil and an eager readiness to believe in agents of evil of a supernatural order. To their minds the world about them, with its imperial government and especially its non-Christian church ritual, was simply a great object-lesson of Satan's unbridled sway. Everywhere they saw the finger of Beelzebub, the prince of devils. These facts, or rather supposed facts, together with various philosophical systems, such as the system of Plato and that of the Gnostics, made the early Christians believe the earth, the sea, the very air, to be full of evil spirits, the emissaries and agents of Satan. Some of these were the spirits which had rebelled against God and had been hurled "sheer o'er the crystal battlements of heaven." Others were spirits which had gone hither and thither, deluding man in the antediluvian world. Others were heathen deities—Jupiter, Mars, Venus, and so on—all of whom, whether they were of good or of evil report among the Greeks or Romans, were equally evil spirits to the Christians. The spirits who, by these Greeks or Romans, were worshiped under the names of departed heroes—heroes who had achieved so many acts of splendid and philanthropic heroism—these were to the Christians not the real spirits of the dead, but merely devils who had answered the name and assumed the honors of the dead. No relation of life was free from this scourge of evil spirits; they even became the husbands or wives of the Christians themselves. Like the locusts of Pharaoh of old, they were over all the land. It is very hard for us now to imagine what all this means—it seems so laughable, these transformations and artifices and disguises to which the spirits resorted to do their master's bidding! But to these Christians of the second and succeeding centuries it was all stern reality—a matter of eternal life and death.

Now, what followed from all this? Simply that no truce was to be kept with, no mercy shown to, the sorcerer or magician; he it was who could send forth and summon back these spirits; he it was whom they must obey. He was worse, far worse, then, than the evil spirits, for the latter only followed the instincts of

their nature, the former went outside the realm of his human nature to blight by supernatural means the happiness of others and to destroy the peace of the Church. He was therefore held in execration—the enemy of God and man. And after a time—i. e., in the fourth century—the Church obtained secular power, Christianity became the state religion. Then began those awful persecutions that have left an indelible stain upon the Christian name. Constantine, the first Christian emperor, had been reared a pagan. He was inclined, therefore, to be lenient. But Constantius and his successors enacted the severest laws. "All who attempted to foretell the future were emphatically condemned. Magicians who were captured in Rome were to be thrown to the wild beasts, and those who were seized in the provinces to be put to excruciating torments and at last crucified. If they persisted in denying their crime, their flesh was to be torn from their bones with hooks of iron. These fearful penalties were directed against rites which had long been universal; and which, if they were not regarded as among the obligations, were at least among the highest privileges of paganism." Of course, the sufferings produced by these laws may have been exaggerated—the laws are plain, they are still preserved in the official Latin—and of course a large part of the barbarity is to be laid not to the Christian priests or to the better classes of the Christians, but to fanatical mobs and cruel officers. But still two things are plain: the Christians believed in magic and witchcraft as the results of Satanic agency; and, again, they indulged in very severe persecution against suspected persons. These laws, however, proved ineffective; they but showed two things which the world has not quite learned even yet: First, that the mere passing of a law does not change human nature; and, second, that a law that is not sustained very strongly by public opinion is worse than useless. It was thus found impossible by law to suppress the old pagan magic handed down from generation to generation among those who had not become Christians. And so, by a very natural process, there grew up in the Church a counter-system, a sort of rival, the talismans of which were holy water, crucifixes, and other signs and symbols, which became in the succeeding centuries the visible means wherewith the designs of the evil spirits were thwarted.

Gradually paganism grew weaker, but it did not entirely disappear. It merged itself into Christianity, a fact never to lose sight of, for it explains so many apparent mysteries. Just as the Roman Catholic Church to-day in various lands—e. g., in Spanish America—has accepted old heathen customs and festivals, and has changed them into Christian customs and festivals; just as, to take another group of examples, the Druidical May day and Harvest Home, and the Oriental Christmas were adopted by the

Christian Church; so at the time of which I am now speaking—i. e., the sixth century after Christ—the Church adopted, under somewhat changed aspects, many of the beliefs and customs of paganism. The mantle of the ancient faith fell upon the shoulders of the new Church.

In the sixth century the dark ages began, and lasted, roughly speaking, until the beginning of the twelfth century. And dark indeed they were. The old light of classic learning and letters had died away; the new light had not yet dawned. The world was sunk in ignorance and superstition. Evil spirits and sorcery held unquestioned sway. As a writer says: "There had never been a time when the minds of men were more completely molded by supernatural conceptions, or when the sense of Satanic power and presence was more profound and universal. Many thousands of cases of possession, exorcism, miracles, and apparitions of the evil one were recorded which were accepted without the faintest doubt. There was scarcely a great saint who had not on some occasion encountered a visible manifestation of an evil spirit. Sometimes the devil appeared as a grotesque and hideous animal; sometimes as a black man; sometimes as a beautiful woman; sometimes as a priest haranguing in the pulpit; sometimes as an angel of light; sometimes actually in the form of Christ. But the sign of the cross or a few drops of holy water, or the name of Mary, could put him to an ignominious flight. The Gospel of St. John around the neck, a rosary, a relic of Christ or of a saint, any one of the thousand talismans distributed to the faithful, sufficed to baffle the utmost efforts of diabolical malice."

In the twelfth century, however, a new idea appeared, that of the witch proper. Up to this time the idea of a formal compact with the evil one had not taken definite form; but in the twelfth century the conception of a witch, as we now conceive it—that is to say, of a woman who had entered into a deliberate compact with Satan, and who was endowed with the power of working miracles whenever she pleased, and who was transported through the air to pay her homage to the evil one—this idea first appeared. The panic created by this belief advanced at first slowly, but after a time with fearfully accelerated rapidity. Thousands of victims were sometimes burned alive in a few years, and every country of Europe was stricken with the wildest panic. But this very twelfth century has been called the turning point of the European intellect. It began to awaken from its sleep of centuries; foreign lands were visited by travelers; Arabian learning began to permeate Europe; and gradually the people became just a little skeptical. Men learned to doubt, but there was as yet no science, as we understand that word; there was no independent inquiry; men began to doubt—but to doubt was still a crime. The Church

saw the change; and, as was her custom, proceeded to crush the new movement, for rebellion against authority was, in her eyes, the one unpardonable sin. The church teaching began to assume, therefore, a more somber cast; the people became more gloomy and fanatical. This is clearly seen in art, which, before the invention of printing, served as an index to the spirit of the age. For example, up to the end of the tenth century Christ was always represented in painting as having a peaceful, gentle face, and as being engaged in works of mercy. The parable of the Good Shepherd was the favorite subject for the artist. But in the eleventh century this began to change: the painters deal with the death of Christ and with the last judgment. Moreover, Christ's face becomes sterner and mournful. In the twelfth century the change is complete: Christ appears stern and unyielding, like the God of old, whom it repented that he had made man. In this age and the succeeding ages occurred also a succession of physical, social, and political events, all tending to heighten and deepen the gloom which seemed to have settled upon men's minds. Chief among these was that awful scourge, "the Black Death," in all probability the greatest calamity that has ever visited the world, by which in six years twenty-five millions of persons, or one quarter the population of Europe, were swept away. Then began a veritable reign of terrorism: men's minds were paralyzed with dread, uncertain fear. They knew not whither to look; they abandoned themselves to the anguish of despair. Then it was that reappeared the Flagellants, scourging themselves and crying aloud like the prophets of old. Then it was that there wandered from land to land those bands of monks whose bodies were ever bleeding with self-inflicted torture; and then there loomed upon the horizon of a startled world the dread figure of the Inquisition, to whose *autos da fé* had been given the task of crushing out heresy and witchcraft. The trials for witchcraft increased tenfold, and in the fifteenth and the sixteenth century the persecution reached its climax. And truly the aspect which Europe presented at that time was in many ways full of discouragement for those who believed in the ultimate progress of humanity. As a great writer has said: "The Church, which had been all in all to Christendom, was heaving in what seemed the last throes of dissolution. The boundaries of religious thought were all obscured. Conflicting tendencies and passions were raging with a tempestuous violence, . . . and each of the opposing sects proclaimed its distinctive doctrines essential to salvation. Yet over all this chaos there were two great conceptions dominating unchanged. They were the sense of sin and of Satan, and the absolute necessity of a correct dogmatic system to save men from the agonies of hell." This was the state of Europe at the time of the Protest-

ant Reformation, a seething mass of conflicting theological parties and opinions: the old Church, acknowledged even by its defenders to be corrupt, making what seemed to many its death-stand against Protestantism; and Protestantism divided into numberless hostile camps, each only with difficulty united against the common foe.

In these matters of history our minds ought to be especially free from prejudice. For example, the Reformation in the end undoubtedly accomplished a vast amount of good. It fostered among the Protestant churches a spirit of liberty and of free inquiry. It rejected multitudes of superstitions and of worn-out theologic dogmas, it simplified the ritual, it encouraged the reading of the Scriptures, it curtailed the power of the clergy. The good effects of the Reformation were felt also after a time by the Roman Church itself—in greater definiteness of statement, in purified morals, in increased zeal. The Protestant Reformation, in fact, produced the reaction in favor of Roman Catholicism, and ushered in that brilliant era of Roman Catholic missionary effort which still, like an aureole of glory, crowns that ancient Church.

But, although this is undoubtedly true, yet it can not be denied that the immediate effects of the Reformation were not entirely beneficial. It unsettled men's minds, it increased the doubt and uncertainty that weighed down upon men, and it in no wise lightened the gloom in which they groped their way. Moreover, "it was for a time only an exchange of masters. . . . The Protestant believed in his own infallibility quite as firmly as his opponent believed in the infallibility of the Pope. 'Faith' still meant an unreserved acceptance of the opinions of others. As long as such a conception existed a period of religious convulsion was necessarily a period of extreme suffering and terror."

As far, then, as the belief in evil spirits and other agents of Satan is concerned, the Protestant churches stood upon the same ground as that upon which stood the Roman Church. By both sections of the Christian world Satan and his angels were believed to be almost omnipresent. For example, Luther, courageous, full of common sense as he was, tells us that in the cloisters at Wittenberg he used to hear the devil talking to him; in fact, he was so accustomed to this that he naïvely relates that once, upon being awakened by the noise, he looked, and seeing that it was *only* the devil, he went to sleep again. The black stain on the wall of the cell at Wartburg still remains: Luther had thrown an ink-bottle at Satan. He ascribed all his ailments except earache—I do not know why he made an exception of that—to the agency of evil spirits. He tells us that the devil frequently caught travelers and strangled them, and transported persons through the air. He had known Satan to appear in court as an innocent barrister;

and, although Luther was extremely fond of children, yet he advised with great earnestness the family of a boy to throw him into the river because he was possessed with a devil.

And thus, by Protestants as well as by Romanists, witches were tortured and put to death in numbers so vast as to seem to us now utterly incredible, the total number of persons who suffered death in Europe and America being at least four millions. In most cases there was a regular judicial trial; in many cases, however, there were various processes for testing the reality of the witchcraft. These methods resembled the ordeals of the olden time. A favorite method was to throw the accused into water. Then, if she did not drown, that was a sign of possession. For how could she be saved except by Satan's aid? if she did drown, that was not conclusive proof of innocence, because God might have taken the punishment into His own hands. However, at that stage of the case, the trial did not possess any further interest to the accused: it was simply a question of clearing her memory.

I have used the feminine pronouns *she* and *her*. This brings up the question why it was that women were supposed to be almost always the ones who entered into this compact with Satan. The answer is, not so much because of the sensibility of their nervous constitution and their consequent liability to religious monomania, as because, from various causes (for example, that Eve tempted Adam, and that women in olden times held an inferior position as to legal rights), women were considered as inherently more wicked than men. In Roman times Cato had said, "If the world were only free from women, men would not be without the converse of the gods." And Chrysostom, the great father, the golden-mouthed orator, had declared woman to be "a natural temptation, a desirable calamity, a domestic peril, a deadly fascination." When celibacy was introduced into the Church, it was regarded as the highest form of virtue, and theologians exhausted all the resources of their eloquence in describing the iniquity of that sex whose charms had rendered celibacy so rare. So it came to pass that women were believed to be especially prone to enter into compacts with the Evil One. These and hundreds of other matters connected with witchcraft are to be found in the literature of the subject which has come down to us from those far-off days. Endless discussions upon all phases and aspects of the question, the volumes stand now in the great libraries of Europe a monument to human credulity and superstition. All phases and aspects of the question, I have said. For example, there was the point whether a witch felt torture or not. The general belief was that she did feel it, but not so acutely as do others, and that therefore the torture ought to be more severe. Then there was another point, that of self-confession. As all know, a confession of

a crime now is not looked upon as conclusive in law, and the accused is not obliged to confess. But in these trials for witchcraft the whole aim of the court seemed to be to extort a confession. For this object torture was resorted to, with the results that multitudes confessed that they were witches and persisted in their confessions until death relieved them. For the confession meant death, its object not being to spare the accused, but to justify the accuser. As a writer has said, "Madness is always particularly prevalent during great religious and political revolutions"—many therefore confessed through madness. Others, of a timid, doubting mind, made themselves believe that, unknown to themselves, they were witches. While "very often the terrors of the trial, the prospect of the most agonizing of deaths, and the frightful tortures that were applied to the weak frame of an old and feeble woman, overpowered her understanding; her brain reeled beneath the accumulated suffering, the consciousness of innocence disappeared, and the wretched victim went raging to the flames, convinced that she was about to sink forever into perdition."

Another very interesting point discussed at great length in these old books was whether the same body could be in two places at once. That the body might be in one place and the mind in another—this was agreed upon; but whether the body might be in two places—that was a harder question. However, it was decided eventually that this was quite possible, and thereafter the fact that wives were at home with their husbands was not accepted as proof that they were not elsewhere in the same form as witches. Indeed, several early saints had this same gift. St. Ambrose celebrated mass in France and Italy at the same time, and St. Clement is well known to have consecrated a church at Pisa while performing mass at Rome. There is no doubt as to this latter point, for there is blood as a proof upon the altar at Pisa; and if this is not his blood, whose is it? Closely allied to this was what is called "lycanthropy"—i. e., the taking of the form of an animal by Satan or one of his angels. There are some most wonderful stories of transformation to be found in the old records, all of which are very ludicrous to us in this nineteenth century, but when, three hundred years ago, it was a question of the stake here and everlasting fire hereafter, they did not appear so full of humor. A French judge named Boguet devoted himself especially to this branch of witchcraft, wrote a book upon it, and burned multitudes of these lycanthropes, his rule being to strangle other witches first, but to burn these without strangling.

So it came to pass that in the fifteenth and sixteenth centuries the skies of continental Europe were lurid with the flames of burning women, and every market place had its fagot and its stake.

But after a time men's hearts and minds revolted from this hideous slaughter. The first book on the Continent that made an effective attack upon the system was by John Wier, a learned doctor of Cleves. In this book Wier took the ground that, although devils are everywhere about us, and although many persons are possessed with devils, yet there are no such beings as witches, and therefore no one ought to be punished as a witch. He said further that, in his humble opinion, a good many persons supposed to be possessed with devils simply had some disease or other which doctors ought to try to cure. This Dr. Wier was a strange sort of man. He published another book, giving various particulars about the lower regions. He was very exact in his figures; and he ascertained that at that time these regions were ruled by seventy-two princes, and the number of devils was 7,405,926. This book of Wier's brought out the ablest defense ever made of witchcraft—a volume by Bodin, esteemed the most learned of all Frenchmen. This book was not answered; and as far as authorities and figures and biblical texts and judicial rulings go, it can not be answered. Still, it did not stem the rising tide against the belief in witchcraft. Humanity and common sense were asserting their sway, and persecution was doomed. In 1588, the very year of the Armada, Montaigne, the great Frenchman, published the first really skeptical work in the French language. This work ushered in the new treatment, the modern treatment of all such questions. He calmly ignored the mass of authority. "I do not attempt," he said, "to untie the knot: I simply cut it. It is more probable that we are deceived, or that men should tell falsehoods, than that witches should exist. And further, it is setting too high a value on our opinions to roast people if they will not accept these opinions." Montaigne had calmly risen above the mists of superstition into the clear realm of common sense and reason. The last witch in France was burned in 1718. After that there were one or two trials, but the prisoners were acquitted; for "the star of Voltaire had risen above the horizon, and the unsparing ridicule which his followers cast upon every anecdote of witches intimidated those who did not share in the credulity."

In Great Britain the first regular enactment against sorcery was in 1541—i. e., at the beginning of the Reformation—although it had been known before that time. In fact, Joan of Arc had been put to death by the command of the English, although on the soil of France and under the sentence of a French judge. Great Britain, indeed, was not so violently affected by this delusion as was the Continent. This for various reasons, her insular position and greater freedom being the chief. So, although Cranmer, the great churchman, he to whom is so largely owing the

Book of Common Prayer, directed his clergy to seek out witches and sorcerers; and although in the reigns of Henry VIII and Elizabeth there were a few executions, it was not until the time of James I that really severe measures were taken; for James I had been reared in Scotland under Puritan influences, and the Puritans were always especially severe upon witchcraft. The king, in fact, had written a pamphlet on the subject; had presided at the excessively cruel torture of a person who had, it was alleged, caused a storm at sea; and was particularly fond of boasting that Satan considered him, the king, as by far the ablest opponent he (Satan) had as yet encountered in this world. And thus in this reign—the era of Bacon and Coke and Shakespeare—England became, like the Continent, the theater of persecution. But all this was as nothing compared to that carried on in the time of the Commonwealth, when the Puritans held sway. Cromwell himself was not inclined to be cruel; but the whole teaching of Puritanism tended toward the belief in witchcraft and the persecution of witches. It forbade amusements, and had thus a tendency to make the people somber and gloomy. It was intensely earnest: the finger of God and the finger of Satan were seen everywhere. Moreover, it developed especially a taste for the reading of the Old Testament, which abounds with references to supernatural events, and the characteristic of which is severity toward those who are not the Lord's people. And the Puritans were the Lord's people, to whom had gone forth the command "to bind the kings with chains and their nobles with fetters of iron." So, notwithstanding all their many good qualities, the Puritans did not err on the side of leniency toward the unfortunate witches. Indeed, in the county of Suffolk alone sixty persons were hanged in a single year. But the Puritan *régime* came to an end, the Cavaliers returned; and these, being of a more light-hearted although less earnest mind, and also being full of dislike for everything that savored of Puritanism, allowed the laws against witchcraft in great part to remain unenforced. Further, the people were becoming more intelligent and humane, and the Royal Society for the study of science had just been established, and French philosophy became the fashion; and gradually England forgot her witchcraft and her persecution. The last executions were in 1712, in which same year the judge on the bench at another trial charged the jury against the belief in witchcraft.

Scotland, however, was not so fortunate. As a writer has said: "The misery of man, the anger of the Almighty, the fearful power and the continual presence of Satan, the agonies of hell—these were the constant subjects of the preaching. All the most ghastly forms of human suffering were accumulated as faint images of the eternal doom of the immense majority of mankind.

Countless miracles were represented as taking place within the land, but they were almost always miracles of terror. Disease, storm, famine, every awful calamity that fell upon mankind or blasted the produce of the soil was attributed to the direct intervention of spirits; and Satan himself is represented as constantly appearing in a visible form upon the earth. . . . Such teachings necessarily created the superstition of witchcraft; it was the reflection by a diseased imagination of the popular theology. Moreover, it was produced by the teaching of the clergy, and was everywhere fostered by their persecution." Thus it is that the annals of Puritanism and Calvinism in Scotland are red with tales of the thumbscrew and the boot and the witches' bridle and the axe and the stake. While the clergy of the Established Church in England were comparatively free from any desire to persecute, while torture was only very rarely resorted to; while, in a word, persecution was carried on by the people in a very half-hearted way, in Scotland there were being enacted, at the express command of the clergy, scenes which rivaled those in Roman Catholic Europe. "And yet these Presbyterian clergymen of Scotland were men who had often shown, in the most trying circumstances, the highest and most heroic virtues. They were men whose courage had never flinched when persecution was raging; men who had never paltered with their conscience to attain the favors of a king; men whose self-devotion and zeal in their sacred calling had seldom been surpassed; men who in all the private relations of life were doubtless amiable and affectionate. They were but illustrations of the great truth that when men have come to regard a certain class of their fellow-creatures as doomed by the Almighty to eternal and excruciating agonies, and when their theology directs their minds with intense and realizing earnestness to the contemplation of such agonies, the result will be an indifference to the suffering of those whom they deem the enemies of their God, as absolute as it is perhaps possible for human nature to attain."

But Scotland also became sick of blood and fire. The last execution for witchcraft was held in 1722, although in 1773 the divines of the associated Presbytery passed a resolution declaring their belief in witchcraft and deploring the general skepticism.

It is not necessary to enter upon the history of witchcraft in America. Its details are known to all. Nothing so clearly brings to one's mind the reality of this delusion and the persecution it entailed as the court papers, preserved as they are in the archives of Essex County, Massachusetts. As one looks upon those faded records and reads of question and cross-question, of plea for mercy and stern refusal, he can again see those awful trials; he

can once more behold the dread procession wending its way amid jeers and scoffs and pitiless execration to what is still "The Gallows-hill of Salem."

It is, in fact, impossible to exaggerate the sufferings produced throughout Christendom by this superstition. "It is probable that no class of victims endured sufferings so unalloyed and so intense. Not for them the wild fanaticism that nerves the soul against danger and almost steels the body against torments. Not for them the assurance of a glorious eternity that has made the martyr look with exultation upon the rising flame as on Elijah's chariot that is to bear his soul to heaven. Not for them the solace of lamenting friends or the consciousness that their memories would be cherished and honored by posterity. They died alone, hated and unpitied; their very kinsmen shrank from them as tainted and accursed. The superstitions they had imbibed in childhood, blending with the illusions of age and with the horrors of their position, persuaded them in many cases that they were indeed the bond-slaves of Satan, and were about to exchange their torments on earth for an agony that was as excruciating, but was eternal." And it is wonderful how long this delusion lasted after judicial punishment in most countries had ceased. In Spain a witch was burned in 1780; in 1807 a beggar was tortured and burned in France; in 1850, in France, a man and wife tortured and killed a woman suspected of witchcraft, and it was with some difficulty that they were punished at all, on account of the lingering belief in sorcery; in 1860 a woman was burned in Mexico, as was the case with several persons in 1874; in 1879 and 1880 witches were burned in Russia; while up to that date, and possibly later, regular judicial trials were held in Austria and Prussia. It is needless to say that almost up to the present, even in England and the United States, persons have been attacked by mobs and private individuals, because it was believed that they were in league with Satan.

But, roughly speaking, this superstition has entirely disappeared; and it has disappeared, not so much through religion as through enlightenment and rationalism. The crushing of this hydra-headed monster of superstition is one small part of the debt the world owes to science.

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SOME drawings recently found by Herr J. Naue at a prehistoric station near Schaffhausen, Germany, comprise, on one side of a piece of limestone, a horse, a foal, and a reindeer, and on the other side several horses. The style is not so fine as that of the Thayngen drawings of France, but the pictures, according to the finder, display a power of keen observation. Herr Naue also remarks that it was more difficult to work on stone than on a bone still fresh.

# STRUCTURAL PLAN OF THE HUMAN BRAIN.

By Prof. CHARLES SEDGWICK MINOT,
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THE human brain is the most complicated organ known, and although its anatomy has been the object of innumerable investigations, often by observers of the highest ability, we are still far from understanding its organization. Within recent years, however, embryologists have turned to the study of the development of the brain, and have succeeded in elucidating many of the obscure features. Here, as in so many other cases, embryology has furnished the master-key to unlock the mystery of the adult anatomy. The series of conceptions which we have derived from our present knowledge of the development of the brain are so clearly established that I regard them as impregnable. They are so far in advance of all previous achievements in the study of the brain that they may be called almost revolutionary, and they are of so fundamental a character that the entire anatomy of the brain and the entire physiology of the brain must be recast to agree with our embryological results.

The present article is an attempt to summarize, as simply as possible, the principal conclusions of recent researches on the nervous system.

Physiologists have long been accustomed to divide nerve fibers into two classes: efferent, or those which carry out impulses; and afferent, or those which carry in nerve impulses to the nervous system. Not infrequently the less accurate terms sensory and motor are used as synonymous with afferent and efferent respectively. The nerves are bundles of nerve fibers, and each nerve is supposed to have typically two roots—one sensory, by which all the sensory fibers enter, and the other motor, by which all the efferent fibers leave, the nervous system. It was supposed that every nerve fiber was connected with a nerve cell in the central nervous system, and that the nerve fibers grew out from the central nervous system. It has long been known that various nerves have thickenings at certain points; the thickenings are the so-called ganglia and they contain nerve cells. The cells in these ganglia were supposed to have migrated from the central parts along the nerves.

The preceding recapitulation of familiar elementary facts will serve to emphasize the following new conclusions: 1. The nervous system consists of two parts, which differ so markedly in their origin and differentiation that it would be hardly an exaggeration to say that there are two nervous systems, for the original duality is never obliterated. The two parts I shall term the

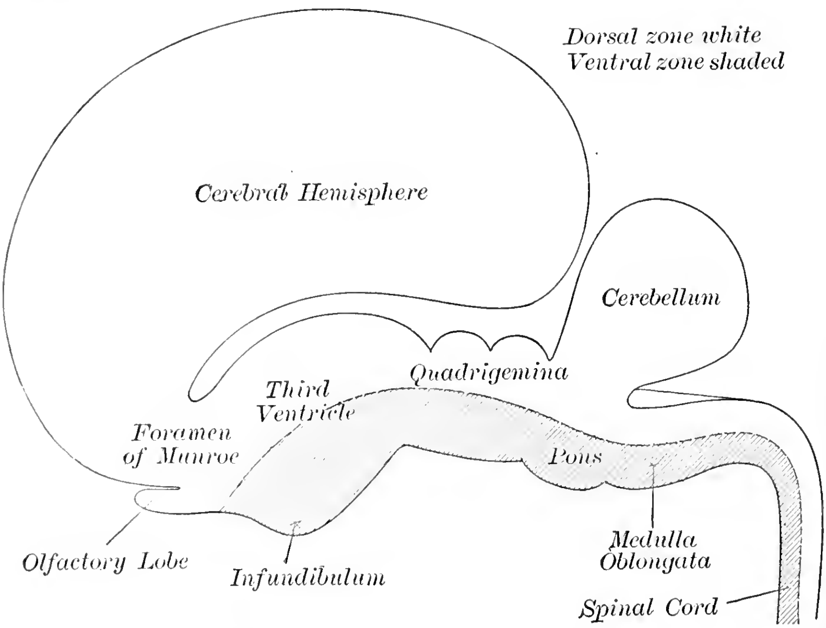
*medullary* and the *ganglionic* respectively. Each part has its special typical cells and nerve fibers. It is further probable that there is still a third class of nerve fibers—namely, those connected with the sensory apparatus of the special sense cells. 2. There are *three* sets of nerve roots—namely, the true *dorsal* roots, which are formed solely by ganglionic nerve fibers; and the *lateral* and the *ventral* roots, which are formed solely of medullary nerve fibers; the lateral roots have been hitherto generally confused with the dorsal roots; they have been traced heretofore only in the brain and in the cervical nerves, but I consider it more than possible that the posterior roots of the spinal nerves will be found to represent both dorsal and lateral roots. 3. Nerve fibers grow out from a cell and the end of each fiber branches; but, so far as observed, none of the branches become materially continuous, either with other nerves or nerve cells or with any other cells or other protoplasmatic structures. 4. The entire brain and spinal cord is divided into four principal longitudinal divisions, which I have named after their discoverer the *zones of His*. The zones are in pairs—that is to say, on each side there is a *dorsal* (i. e., in the spinal cord "posterior") and a *ventral* (i. e., in the spinal cord "anterior") zone. These zones are of fundamental importance, because all the fibers which belong to the ganglionic portion of the nervous system ramify in the dorsal zone, while all the fibers belonging to the medullary portion leave the spinal cord (or brain) through the ventral zone. Both zones persist throughout life, and preserve their fundamental relations to the two kinds of nerve fibers.

Let us now attempt to acquire fuller and more exact conceptions in regard to the four discoveries above enumerated. We may hope to do this without entering into technical details and with the use only of terms readily understood. At the same time we shall learn wherein the significance of the four discoveries lies.

The First Discovery.—The division of the nervous system into a medullary portion and a ganglionic portion has to be explained. The division has long been a familiar fact to anatomists, but its true character and fundamental significance have been known a short time only, because it is owing to very recent embryological discoveries that the independent development of the ganglionic portion has been elucidated. The existence of the ganglia has long been known, but their development independently of the rest of the nervous system is a new conception. Their independence is, of course, not absolute but relative, for every part of the body develops in intimate relations with, and in dependence upon, the neighboring parts.

By the medullary portion we understand the brain proper plus the spinal cord or marrow and the nerve fibers, which grow

out from the brain and spinal cord. The brain and spinal cord, since the days of the celebrated investigations of Karl Ernst von Baer, have been identified as modifications of a single long tube, the so-called medullary tube of embryology. This tube, as the embryo advances, gradually increases in complexity, especially in the region of the head, until it is converted into the brain and spinal cord. The complications which occur may be conveniently grouped under four heads—namely, the flexures, the widening of the cavity or its obliteration in a way varying for each region, changes in the thickness of walls, and lastly an extreme differentiation of the microscopic organization. Without detailed explanation it may be readily conceived that by the varying co-




operation of these factors great differences arise in the sundry parts of the originally simple medullary tube. On the other hand, in the most fundamental characteristic, the production of nerve fibers, the same principle governs brain and spinal cord alike. There appear very early certain cells, which soon become recognizable as young nerve cells (neuroblasts) because of their size and pointed shape; the pointed end now elongates into a very delicate thread, the nerve fiber, which is at first very short but rapidly lengthens almost like a growing root; the growing fiber takes its course for a certain distance, varying according to circumstances, within the wall of the medullary tube, but ultimately passes outside the tube into the neighboring tissues together with other nerve fibers of similar origin. It must be added that some

of the nerve fibers are of the Golgi type—that is to say, they end as well as begin within the central nervous system. The bundle of nerve fibers which pass out together constitute a nerve, or, to speak more correctly, a nerve root. So far as yet observed no exception occurs; therefore we may safely assert that every nerve cell of the brain or spinal cord produces one nerve fiber and only one, and this fiber grows out from the nervous system into the tissues of the body. The fiber is single at its origin, but since we always find the peripheral fibers branching, we may add that the fiber is multiple at its termination. The nerve cells acquire also other secondary branches—the so-called protoplasmatic processes or dendrites—which grow out from the cells, but are not nerve fibers and are confined in their growth to the nervous tissue itself. The secondary branches present highly characteristic variations in the different regions of the brain, as described in the text-books.

By the ganglionic portion we now understand the nerve cells which lie in little groups outside of the medullary tube. These cells produce fibers, which grow in two directions—on the one side into the brain or spinal cord, on the other away from the brain and cord into other tissues and organs. It has been observed that the ganglionic nerve cells elongate and become spindle-shaped; each pointed end of the cell grows out into a nerve fiber; as the nerve cell connects the two fibers, we may describe the actual condition accurately as resulting in a single nerve fiber, which has a nerve cell interpolated in its course. Each group of nerve cells forms a bundle of nerve fibers, which constitute the posterior (or so-called dorsal or sensory) root of the anatomists. If we follow a ganglionic fiber into the spinal cord or brain, we find that it forms two branches, as first recorded by Ramon y Cajal, a distinguished Spanish histologist; of these two branches, one runs upward, or in the brain forward, and the other runs downward, or in the brain backward; each fork gives off secondary branches (collaterals), that ramify still further, and are all situated within the central nervous system proper. If we study the termination of the ganglionic fiber at its other end—that is to say, in the tissues or organs—we find that there also there occur several ramifications. These fibers, like the medullary fibers, have each a single origin, but, unlike the medullary fibers, have *two* sets of multiple terminations. Although both the peripheral and central terminations have been carefully studied, they have never been found connected with other structures or cells, but only to be in contact with them.

The true history of the ganglia and their nerve fibers has been elucidated chiefly through the masterly researches of Wilhelm His, Professor of Anatomy at Leipsic, who is the recognized highest living authority on the development of man. This addition

to our knowledge of the nervous system is perhaps the most important which has been made during the last generation. It teaches us that the nervous system comprises two sets of nerve cells and fibers, which differ not only in their situation, but also in their development and distribution. We are already in a position to say that the entire physiology of the brain must henceforth be based upon this discovery of the independence of the ganglionic system, because the same laws can not apply without change to structures so differently organized as are the two portions which we have briefly characterized, and there can be no doubt that the functions are as fundamentally divergent as is the organization. It is, however, still too soon for cerebral physiology to have remodeled itself, but that remodeling must follow, since physiology always bases itself on the anatomical facts.

Besides the two classes of nerve fibers, the medullary and ganglionic, we may have to add a third. In the organs of special sense (sight, hearing, smell, and taste) there are found the peculiar sensory cells, which all present two special features: First, they have characteristic modifications of cellular structure, by which they are adapted to receive sensory impressions; second, they are each united with a single nerve fiber. It has long been, and indeed still is, the prevalent theory that the nerve fiber arose from the brain, grew to the cell, and united with it. Merkel was, I think, the first to suggest that the sensory cells are also true nerve cells, the nerve fiber springing from them and growing to the brain. This view has been brought into fresh prominence by the discovery made by Michael von Lenhossék that Merkel's supposition is true in the case of the earthworm, which has cells scattered in its skin, each cell giving rise to a nerve fiber, which must arise from the sensory cell since it is connected with no other cell, although it enters the central nervous system and there ramifies.

The Second Discovery.—For the recognition of the three sets of nerve roots also we are indebted to the researches of His, published in 1888. Previous to that time anatomists recognized two roots only—the posterior or dorsal roots, and the anterior or ventral roots. In the spinal cord it was easy to maintain Bell's law, that the posterior roots are sensory; the anterior, motor or efferent. The cephalic nerves, however, could not be brought into accord with this law, because of numerous difficulties, of which one may be mentioned as an example. The nerve called the facial was found physiologically to be both sensory and motor, and yet was shown embryologically to correspond to a posterior root. Through His we learned that the cephalic nerves corresponding to the posterior roots have in reality compound roots, being double. In fact, the nerves of the class referred to consist each of a bundle of ganglionic fibers which enter the brain and branch in its dor-

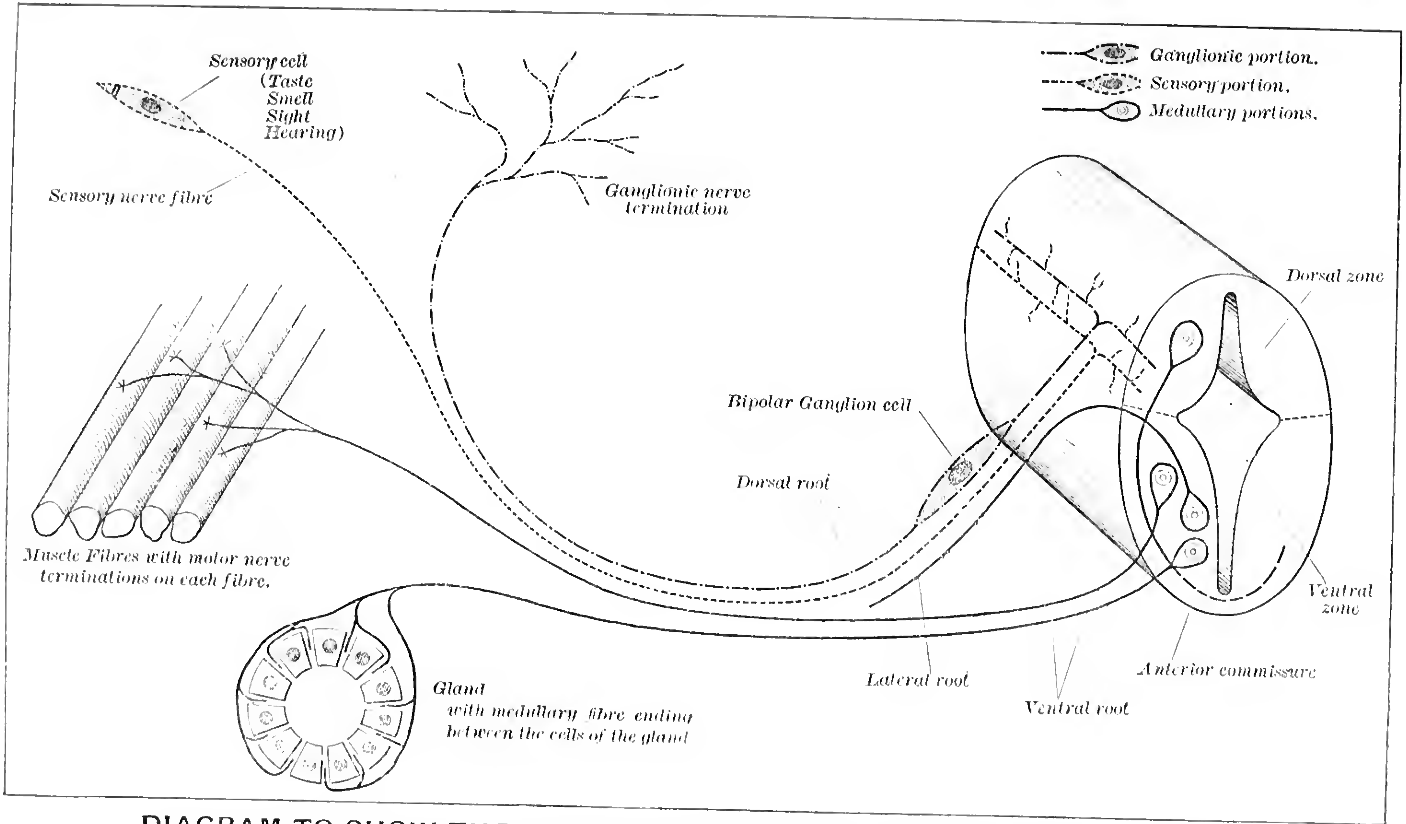



DIAGRAM TO SHOW THE ORIGIN AND TERMINATIONS OF NERVE FIBRES.

sal regions, and of a bundle of medullary fibers, which arise in the ventral portions of the brain and pass out from it immediately below the entrance of the ganglionic fibers. Evidently there are two roots, which, from their close juxtaposition, have been hitherto unrecognized; the ganglionic bundle is the *true dorsal root*, the medullary bundle the *lateral root*. If, now, we modify Bell's law by saying that all medullary fibers are efferent or motor, and all ganglionic fibers afferent or sensory, we can understand the double function of the facial nerves and of the other nerves resembling it—to wit, the trigeminal, glosso-pharyngeal, and vagus.

The recognition of the lateral root as distinct from, though joined with, the dorsal sensory root, removes many obscurities in the anatomy of the nervous system. We know that lateral roots are not confined to the nerves of the head, but they also occur in the upper cervical nerves, and I regard it as highly probable that with the progress of research they will be found sharing in the formation of other spinal nerves. Should this expectation be fulfilled, the long-established conception of the posterior roots as purely sensory will have to be modified, although it has reigned for three quarters of a century as one of the fundamental conceptions of physiology.

The Third Discovery.—The third discovery is that neither the nerve cells nor nerve fibers are directly continuous either with other nerve cells or with the cells or structures of other tissues and organs. Every nerve cell, together with its fiber, is an entity, and is not organically continuous with anything else. It is certainly premature to affirm this discovery positively, for we can say at present only that the consensus of the best opinion, of such men, for instance, as His and Kölliker, is in favor of the conception that every nerve cell plus its nerve fiber is an isolated element. Until recently the hypothesis was received with favor that the cells of brain and spinal cord were connected by threads of protoplasm, or, to speak more precisely, by branches of the processes of the cells; according to this hypothesis, there would be a direct protoplasmatic continuity between the different parts of the nervous system, and therefore a nerve impulse brought by a sensory fiber to the brain could be conceived as traveling along an uninterrupted pathway of living matter until it produced its final action. In many text-books of physiology there are diagrams to illustrate the theory of a continuous pathway. It is evident that if there is no such connection between nerve cells as assumed, then we must radically alter our conceptions of the process of the transmission of nerve force through the brain.

In the question before us, Camillo Golgi and his followers must lead the way. Golgi, whom the world will probably rank

among men of genius, has unquestionably done more than any other man living to enlarge our knowledge of the minute structure of the brain, for we owe to him, besides invaluable researches, the invention of an entirely novel method of study, by which a few of the cells of the brain are marked out with the utmost distinctness by a deep deposit of color, while most of the cells and tissues of the brain are left translucent and lightly tinged. The finest ramifications of these cells can be followed in such preparations under the microscope, yet they have never been proved to unite with the ramifications of other cells. Another method is that which consists in treatment by chloride of gold, as long employed in histology for tracing the finest thread of nervous substance, yet with this also it has hitherto been impossible to demonstrate any actual continuity of cell with cell. There are, however, certain authorities who still uphold the older view. Thus Adam Sedgwick, guided by certain general theoretical considerations as to the laws of cell connection, expects to find the continuity hypothesis re-established. Recently Prof. Dogiel, of the Siberian University at Tomsk, has published an article in Russian, in which he apparently seeks to verify the same hypothesis by actual observation, but unfortunately his results are not yet fully accessible to me. The settling of the problem is beset with the greatest difficulties.

The physiological consequences of the theory of non-continuity reach very far. Thus, if the sensory fibers simply branch within the brain, then there must occur a leap from those fibers to the cells which are to send out the reflex response to the sensation. So in other cases there must be a leap from one cell to another. Perhaps the leap or transfer is comparable to an electric induction. But it is obviously useless to ramble into sheer speculation.

THE FOURTH DISCOVERY.—The zones of His were vaguely recognized by Löwe, but to His belongs the honor of having first clearly recognized them and established their morphological importance. There are four zones of His—two on each side; they run the entire length of the brain and spinal cord, except that in the partially aborted end of the latter the zones are imperfectly developed. Each zone is a thickening of the wall of the medullary tube. We distinguish the dorsal and ventral zones. The dorsal zone was termed by His the *Flügelplatte* (wing plate) and the ventral zone the *Grundplatte* (basilar plate), but the new names proposed appear to me preferable. At an early stage of development the two zones are very clearly marked off from one another; but after a more advanced stage is reached, although they preserve their characteristic differences, their delimitation is far less conspicuous. They persist throughout life, and can be identified in the adult. Thus, for example, in the cerebral region proper, or,

as commonly termed, the region of the third ventricle, is a groove known as the sulcus of Munro, which runs from the opening which is termed the foramen of Munro, along the lateral wall of the ventricle, backward to the narrow continuation of the ventricle which has received the fanciful name of the aqueduct of Sylvius. This groove, the exact position of which I have thus indicated for the sake of possible anatomical readers, is the boundary between the dorsal and ventral zones. The superficial character of our previous knowledge of the brain is emphasized by the fact that the sulcus of Munro is usually not mentioned or figured in anatomical text-books, and yet we can say now that it is the most important landmark to be found in the part of the brain in which it occurs. It will suffice to give one other example: In the spinal cord the structure known by the name of the posterior fissure—a singular misnomer, since it is not a fissure—arises by the growing together of the two dorsal zones; a line drawn from the bottom of the so-called posterior fissure to the entrance of the posterior nerve roots would represent approximately the boundary between the dorsal and ventral zones. These two examples can, of course, be clear only to anatomists, but they demonstrate the permanency of the zonal divisions.

We have already learned that the fibers which arise from the nerve cells of the ganglia outside the nervous system proper enter the dorsal zone of His and there fork, the forks running longitudinally within the zone but in opposite directions. Gradually the number of fibers running in the zone increases until they form a fibrous tract of considerable size. The tract is originally situated next the outer surface of the nervous system; in the case of the spinal cord it remains permanently upon the outside, and therefore, as the nerve fibers ultimately become white in color, there is the so-called "white substance" covering the outer portion of the dorsal zone of the spinal cord, and it is this covering, which is known anatomically as the posterior columns,* and which overlies all the medullary nerve cells that form part of the interior or "gray matter." In the brain also there enter several nerves, the ganglionic fibers which are distributed in precisely the same way as those just described—that is, they produce a superficial layer in the dorsal zone; they may be seen in this position during early stages in the part of the brain (medulla oblongata) adjoining the spinal cord. By secondary processes there follows a spreading of the nervous tissues over the outside of this white matter. We then have a white matter buried and isolated, but it remains, what it was primitively, the direct continuation of the superficial

* Including the postero-lateral columns, the columns of Burdach, and perhaps also the columns of Gol.

layer of the spinal cord. The bundle of nerve fibers is known as the solitary tract. Although the relations are complicated and not easily rendered clear, I hope enough has been said to demonstrate that the dorsal zone always remains what it is at first—the zone into which the ganglionic fibers enter and in which they chiefly ramify.

As every one knows, the two largest divisions or parts of the human brain are the cerebrum or hemispheres and the cerebellum. These, we have now learned, are both structures developed exclusively from the dorsal zones of His, and have therefore a very different morphological value from what has hitherto been assumed—not being modifications of the whole brain, but only local developments of the dorsal half of the brain. Just as primitively the medullary fibers which arise in the dorsal zone pass into the ventral zone, so in the specialized cerebral hemispheres and in the cerebellum there arise very numerous nerve fibers, but these still obey the primal law and take their courses into the portions of the brain representing the ventral zones, and thence the fibers are distributed to their various destinations. Until the relations of the zones to the nerve fibers, on the one hand, and to the hemispheres and cerebellum on the other, had been embryologically determined, it could not be known that the course of the cerebral and cerebellar fibers is in accordance with a fundamental law of nervous organization. We can foresee, though somewhat vaguely, that essential physiological deductions will follow the application of the law to the study of the functions of the brain.

The relations of the zones in the entire brain are indicated by the diagram on page 374, which scarcely calls for comment, since it sufficiently explains itself. I need only add that the position of the dividing line of the zones in the region of the corpora quadrigemina is somewhat uncertain. In the embryo this region is known as the mid-brain, and shows the primary division very clearly; but as the further development has not been worked out properly yet, we can not decide positively as to the exact demarcation of the zones in the adult.*

The ventral zone of the brain may be defined, as we have already learned, as the territory of the medullary fibers, for it furnishes the pathway for those fibers to collect in bundles, which may either form nerve roots (ventral or lateral), or may cross, as so-called commissural fibers, from one side to the other in order to establish the nervous connection between the two halves of the

* I am led to suppose that the dorsal zones of the mid-brain unite, but that the ventral zones do not, and that therefore the aqueduct of Sylvius lies entirely between the ventral zones, the dorsal portion of the original cavity in that region of the brain being obliterated. It is very possible that this supposition is incorrect.

brain or spinal cord. Most all the nerve fibers produced within the brain enter the ventral territory, for in this territory we observe not only the fibers which it obviously must include—namely, those which are produced by the nerve cells of the ventral zone—but also the nerve fibers produced by the nerve cells of the dorsal zone. So far as at present known, the nerve cells of the dorsal zone all produce nerve fibers, but these fibers always pass into the ventral division of the nervous system. These fibers of dorsal origin are the chief, perhaps the only ones, which are commissural—that is to say, which pass to the opposite side of the brain; others of these fibers take longitudinal courses within the ventral zone; while still others participate in the formation of the nearest ventral (or anterior) nerve roots. If, therefore, we assume that the sensory nerve impulses are carried into the dorsal zone and there transferred to the medullary nerve cells, we must conclude that from those cells the impulse may be sent along medullary fibers either into the opposite side, or up and down the ventral zone, or into a neighboring nerve root. The center of divergence is the dorsal zone, but the actual divergence of the fibers takes place in the ventral zone.

Although the ventral zone receives medullary fibers and itself produces nerve fibers, it sends, so far as yet observed, no fiber into the dorsal zone, but all the fibers which leave the ventral zone form nerve roots and leave the nervous system altogether. These roots, as we have already learned, are in two sets—the lateral and ventral.

Summary.—The numerous facts which we have marshaled in hasty review so greatly widen our knowledge of the nervous system that it is important to render them as clear as possible. If what has been presented be critically considered, it will be found that what we have gained is an enormous accession of knowledge in regard to the nature, origin, distribution, and connections of nerve fibers. In order to make the typical variations of nerve fibers as evident as possible, I have constructed the accompanying diagram, which is, I think, correct for all which it attempts to give. We notice: *First,* that the central nervous system is a medullary *tube,* the walls of which form two dorsal zones and two ventral zones. *Second,* that every nerve fiber arises from a single cell only, and is nowhere united with any other cell. *Third,* that every nerve fiber has a branching termination. *Fourth,* there are three kinds of nerve fibers: (1) Medullary, which arise from the nerve cells of the central nervous system proper; of the medullary fibers three kinds are distinguished—namely, those which pass out to form the ventral root, those which pass out to form the lateral root, and those which pass as commissures to the opposite side of the tube; there are also medullary fibers which run

lengthwise of the nervous system, but these are not represented in the diagram; second, ganglionic fibers, which run from the bipolar ganglionic nerve cells in two directions, and have two terminations, one branching within the medullary tube, the other branching to form peripheral sense organs; third, peripheral sensory fibers, which spring from the nerve-sense cells; that fibers of such origin exist is well known, but that they enter the central nervous system and there ramify, as here depicted, has as yet been actually demonstrated only in the earthworm. *Fifth,* that all the ganglionic and peripheral sensory fibers enter the dorsal zone only, while all the medullary fibers make their exit from the ventral zone only.

If we can reason from the structure, we must conclude that all the complicated functions of the brain depend upon four primary sets of functions—*namely,* 1, 2, and 3, the functions of the three classes of nerve cells, together with their connected fibers; and 4, the function of transferring nerve impulse from one fiber to another. Until physiologists and psychologists shall have learned to differentiate the four sets of functions, and have invented successful means for their separate investigation, cerebral physiology is, in my opinion, likely to remain, what it has so long been, a science of unsolved problems.

## THE AMERICAN WOMAN.

By M. C. DE VARIGNY.

IN essential characteristics—by tradition, by nature, and by education—the American woman is the direct antithesis of the woman of the East, of her of whom the Hitopadésa says, "A woman should be under the watch of her father during infancy, of her husband in middle age, of her sons in old age, and never independent." In the United States she is under the watch of no one, but under the protection of all.

If by the aid of historical documents we reconstitute the colonial situation in America as it was in the beginning, we find the man absorbed in daily work out of doors and the woman in her tasks within, and equality of the sexes resulting from equality of burdens and responsibilities; then, as prosperity increases, the task of the woman diminishes while the burden of the man remains the same, and the leisure of the former contrasts with the severe labor of the other. Woman's intelligence develops and extends; man's becomes concentrated and specialized, his education is limited, and remunerative labor awaits him and takes him away early in life. She, the equal and companion of man at the begin-

ning, becomes gradually superior to him, by the leisure which he creates for her and the use she makes of it, in intellectual cultivation, in the variety and extent of her knowledge, and by the lead which she is able to take and keep. She is the resultant of a concurrence of circumstances which have not yet been found united in a like degree anywhere else, and which have all contributed to make her a superior type of the race. In her are combined and fused the characteristic traits which, more specialized in the man, appear accentuated, magnified, exaggerated, as well by the free play of natural instincts as by the necessity of furnishing himself with arms in the struggle for existence and of demanding from them the maximum of force and of practical utility. In the woman these characteristics persist, but they are tempered and held in; she smooths their angles and polishes their facets, and of a dull pebble makes a precious stone. The constituent parts remain the same, but a judicious cutting sets the luster and beauty of the stone in clear relief.

Those who find more to blame than to approve in the American young woman, who are shocked at the freedom of her ways, at her independence, at her scorn of social conventions, at her luxurious tastes and her fondness for admiration, have often made those traits the text of their accusations against the democratic institutions of the United States. According to their reasoning, the result could not be otherwise, given the same premises as a point of departure, namely, the customary association of young women and young men, equality of the sexes raised to an axiom, abdication of parental dictatorship, independence of children, and freedom of matrimonial choice. The eccentricities noticed by them are, in their view, the inevitable consequences of a democracy hostile by instinct to the principle of authority, endeavoring to reduce it everywhere to its minimum of action and control, extolling equality with an apostolic zeal and practicing it with the fervor of a neophyte. And now these pretended apostles of equality, these self-styled levelers of privilege, have ended with re-establishing inequality with the advantage on the woman's side, with making her the eminently privileged person, and, reversing the Asiatic conception, of elevating her into a despot and converting the man into a subject. It seems to us, however, that the influence of political institutions on social habits has been very much exaggerated. Unstable and mobile, the former change at the caprice or the passions or the necessities of the moment. Not so with that aggregation of usages and customs which rests upon uninterrupted traditions, upon a long transmission. They undergo modification, but slowly; they are the results of the experience of centuries, and never proceed by jumps in their evolution. More of the fundamentally primitive than is usually believed re-

mains common to the Americans and the English in their relations to women; and the large place given to woman in the United States, and the greater independence she enjoys, flow as much from the change of medium as from the advanced intellectual position which she was able to take at the beginning and has long held.

But as the United States grows and becomes more refined, the difference between the sexes in this respect is diminishing. Yet while man has to a large extent recovered possession of the vantage-ground in mental cultivation occupied by woman, and while his stronger faculties, more robust organization, and more sustained will give him the superiority everywhere else, there is a social domain from which he could not and would not dispossess her—a domain hers by tradition and by concessions which he has made and she has accepted and extended. At this point becomes manifest the contrast between the Anglo-Saxon and the Latin races, the antithesis between the conception of the East and that of the West, the two poles of which are Asia and the United States, while its mean term is found in central and southern Europe. To these two poles correspond, in effect, a maximum and a minimum of human personality. This personality is nowhere so intense as in the United States, and nowhere less so than in the extreme East. England transmitted to the United States, with that basis of personality peculiar to the English race and more accentuated there than anywhere else in Europe, that respect for individuality which made itself manifest at an early period in British laws and institutions.

Cantoned in her family and social domain, the American woman has till this time made only rare and timid incursions into the field of politics. But in the field in which she usually moves, we are struck, on a close examination of the various phases and details of life in the United States, with the important place she occupies. This is true to a higher degree in modest conditions, in the agricultural districts, in the farms and settlements and in populations of working people, than in the large cities. Not that these, too, do not contain curious types for study, essentially original, and tending in a high degree to reconcile the exigencies of the external features of modern life with lofty aspirations and an active philanthropy.

Given, as the points of departure for woman's position in the United States, equality with man, intellectual and social predominance, with the charms of her sex refined and developed by natural selection, by unions between young women free to choose and a race of colonists energetic, vigorous, deeply imbued with religious convictions, and respecting the conjugal bond, woman must necessarily appear, at any given moment, as the definite ex-

pression, the superior type of the race and the medium. She is to-day, what the American exhibits her in Europe with a legitimate pride, the most finished work of the country's two centuries of civilization.

It seems as if on the American soil, essentially democratic, Nature showed herself, in what concerns woman, more aristocratic than elsewhere, and that the genius of natural selection was working perpetually for the advancement of its elect. Of all these gifts which it has lavished upon her, one of the most characteristic is certainly adaptability. Few women in Europe possess in the same degree as the American woman the faculty of identifying themselves with their medium, of changing country, climate, and surroundings with so wonderful suppleness. More perfectly than others, she accommodates herself to circumstances, while she preserves her individuality in a strange surrounding.

Wherever we meet the American women—and we meet her everywhere, in the ranks of the English peerage and of the highest European aristocracy, as well as in more modest conditions—we are struck with that marvelous adaptability in which wise men see the sign of the superiority of a race or of a species. It is revealed notably by that good humor with which she accepts the numerous petty annoyances that every change of medium implies and which put the best characters on trial. She submits to them without effort, and criticises them without bitterness: she is, further, prepared for them by her education, and does not expect to find everything easy. Then the necessity of manual labor does not seem to her like a degrading condition; at most only one or two generations separate her from the time when her grandmother kneaded the family bread in the primitive settlements. These stories are familiar to her, and the lessons deduced from them are not discouraging or humiliating. She is the daughter of a race of emigrants who have become a great people through work, energy, and determination. She has in this at her command a whole treasury of traditions from which she draws, not without pride. We might say, in listening to these stories, that we were hearing one of those *grandes dames* of the past century, emigrants and poor, telling with pride in their memoirs how, to supply their wants, they worked in London or in Germany, utilizing their accomplishments and their correct taste, and making trimmings and embroidering robes with their own aristocratic hands.

The American woman has no more false shame and silly conceit than they had. We can observe her at Paris, Nice, Pau, or in Switzerland, everywhere at ease, the first to laugh at her mistakes in language, or at her ignorance of continental usages. Wherever she may be she seems to be at home; and the country

that pleases her is, during the time she lives in it, her adopted country. The thought never occurs to her that she may be ridiculous or may appear so; or that a woman can be ridiculous or a man think it of her. Such is the confidence, justified by experience, which the privileges of her sex give her, that she has neither timorous reserve nor sickly timidity. Homage paid to her as a woman does not embarrass her, attention does not disconcert her. She is accustomed to them, and freely confesses the pleasure they cause her.

She is the resultant of a mode of education, of a kind of life that differs profoundly from ours. She has been taught to rely upon herself, to judge for herself. In her relations with men she has always been free but responsible, guardian of her own honor, and artisan of her future. She has seen and observed; she is not ignorant of the duties of life, or of the perils of independence. If the objection is made that this too premature knowledge is often liable to render her under a brilliant and sportive exterior coldly calculating and too early cautious, we may answer that she will sooner or later have to deduce her own conclusions from what surrounds her, of the world in which she lives, and that it may be better for her eyes to be opened to evidence and her judgment to be formed before making the decisive choice of her life.

It is hard in examining such a question to abstract one's self sufficiently from the usages and the ideas of the medium in which one lives—to be absolutely impartial. By instinct we are inclined toward accepted ideas, usual customs, and current axioms. Our own ideas are still too far away from those of the people across the sea for strong contradictions not to arise between them. In such a matter experience only is of value, and we can judge equitably only by results. Here experience is conclusive and the results are satisfactory.

If the American Union is to-day one of the first countries in the world, it owes the fact to a large extent to the American woman, who was and still is an important factor in its astonishing prosperity. The United States owes it to her that it has preserved the religious faith, the principle of vitality, imported by the Pilgrim fathers to the American shores. She has been the efficacious artisan of the work. She has maintained it, extended and enlarged it in the church and the school. In hours of difficulty, as during the war of independence and the war of secession, the patriotism of the woman sustained the courage of the man. Under all circumstances she was his companion and his equal. As such he respected her, and that respect which she inspired in him by her self-denial and her courage in the beginning, by her intelligence and good breeding afterward, by her charms and her confidence in his protection, has fashioned American manners, and has strongly

impregnated them with the idea that respect for his companion was for the man one of the prime conditions of moral life. This moral life is her own work. She created and she maintains it. In the cult of which she is the object, in the homage which man renders to her, there is more than the mysterious attraction which sex inspires: there is the instinctive recognition of a great and salutary influence nobly exercised.—*Selected and translated for The Popular Science Monthly from the author's article in the Revue des Deux Mondes.*

## TEACHING PHYSICS.

By Prof. FREDERICK GUTHRIE, F. R. S.

THERE is no physical science without exactness, and there is no exactness without measurement. Far as we are still from understanding the mystery of life, it is not to be denied that the greatest advances in biology have been due to exactness in observation and quantitative comparison. This is more markedly the case with the sciences of geology and astronomy. Still more is this to be insisted on in the study of the forces of inanimate Nature. I have always, for instance, tried to persuade those of my friends who are engaged in teaching chemistry that they would do well to begin at once with quantitative methods and determinations in the laboratory, synthetic as well as analytic.

This quantitative element is still more essential in physics. There everything should be quantitative and exact. But there are different degrees of exactness. No one would expect from the average student of chemistry that all his analyses should be of the same degree of refinement as though he were determining the atomic weight of an element. Let his analyses be sufficiently exact to convince him of the faithfulness of Nature and the trustworthiness of the statements of the science.

Now, in bringing before you to-night a short account of the system of teaching practical or laboratory physics which has been adopted at the Government Science Schools with which I am connected, I must speak a few words as to the origin of that system.

The problem was briefly this. Given a class of students of various ages, from sixteen to sixty, and of various degrees of general knowledge and ability. Assume that they are all anxious to learn, and that none of them have worked systematically before in a physical laboratory, and let the instruction be limited to a few months—say four.

The problem is to give them a sound but necessarily elementary training in the science, so that all shall have an opportunity of acquiring such a knowledge of physics as no educated man should

be without, and no scientific man dare to be without, and to those who have the ability, the opportunity, and the desire, a trustworthy foundation on which to base their further studies.

The scheme almost necessarily formed itself into the following: The student attends a lecture every morning, except Saturday, at ten o'clock. These lectures, in the present case, are about seventy in number. At eleven o'clock he goes into the laboratory, provided with a few tools; there he finds the necessary material for making apparatus relating to the lecture. He has also printed instructions directing him how to make and how to use the apparatus when made. He finds also working models of such apparatus for his guidance. These instructions he carries out under the supervision and advice of a skilled assistant.

The instruments the student of average skill can and does make under proper instruction with these means are far more accurate than those he is at all likely to be able to buy. I do not say that his divided circles will be as accurate as those of Troughton and Sims, nor will his spectroscope compare with one of Hilger's, nor his resistance coils with those of Elliott, nor his barometer with the one at Kew; but I do say that his barometer is a far more exact instrument than one for which he would have to give several pounds; that his spectroscope will divide the sodium line; that his coils are true to the thousandth of their nominal value; that he can determine the wave-length of light to within $\frac{1}{1000}$ of the truth, the specific heat of a metal to $\frac{1}{100}$, and the length of a sound-wave to $\frac{1}{200}$ of the truth. The only bought instrument of precision which the student uses in the elementary course is the balance. He has generally, however, acquired some skill with this, and in the manipulation of glass, in the chemical laboratory.

Starting with a tuning fork which is given to him, and the monochord which he makes, the student is able to verify the intervals of the gamut as dependent on length of string. He then examines the effects of variation of diameter, of tension, and of weight of the string.

Tuning forks are, however, seldom exact. The actual pitch of the fork is found by the method of sinuosities. A smoked glass plate is dropped in front of a style on the fork, and so the fork writes its own number. Hence, by means of the length of the resonant cavity, the velocity of sound in air is obtained with some accuracy, and by the method of longitudinal vibrations the velocity in wood, glass, and brass, etc., follows. The rule of the transverse vibrations of rods is examined. The production of harmonics on strings, rods, and in tubes is shown, and a number of experiments follow concerning the velocity of sound in different gases as determined by dust figures.

Having made and graduated both a direct alcohol and a differential air thermometer, the absolute expansions of water and alcohol are determined. Very accurate results may easily be got as to the latent heats of water and steam. Then the student, having made his calorimeter, determines the specific heats of iron, copper, zinc, tin, and lead. The specific heats of a few liquids are determined either by direct comparison with water or indirectly with the metals.

In light, the chief work consists of the following: The making and use of the diaphanous and shadow photometers; the making of an instrument for examining the rules of reflection and refraction, and the verification of these rules; the determination of refractive indices of liquids and their dispersive powers; the images from curved mirrors, the measurement of focal lengths, and the curvative and refractive indices of lenses. A few experiments concerning plane polarized light are followed by the determination of the wave-length by a grating, and the construction and use of the spectroscope.

The principal pieces of apparatus constructed for work in electricity are: A gold leaf electroscope; a differential condenser; a sand-dropping accumulator; a Leyden jar; an electrophorus; a dry pile; a voltaic cell; a differential galvanometer; a resistance bridge; a set of resistance coils; a tangent galvanometer; a potentiometer; a thermo-element; a thermopile. And by these apparatus typical experiments and measurements, of which the following are a few, are made: The study of magnetic curves; the action of the current on the needle; the relation between length, weight, and resistance in wires; the effect of temperature on resistance; the law of divided circuits; specific resistance; electromotive force; internal resistance of cells, and so on.

Electricity, especially voltaic, lends itself perhaps more abundantly to exact measurements in the elementary laboratory than the other branches, and it is on this account, and because it is the last subject treated of, and so claims any spare time at the end of the term, that it occupies a rather prominent part. I do not hold that it has really any greater educational value than the other branches, and certainly in a general educational course it is not for me to give it prominence, because just now it has a considerable technical development. I trust the time may never come when any branch of physics will be considered as of comparatively little importance in general education.

To-day I have particularized the method of teaching one branch of science. I have had to use strong language, for I feel strongly, and I have been addressing strong people. Of this, at least, you and all men may be well assured, that I will not cease to proclaim, as long as strength is given to me, that the hope of

science is the hope of the world; that while I yield to none in my love of imagination, of literature, and of all the fine arts, they are as the gracious flowers of the mind-plant whose leaves and roots are the truths of science. True that the living plant is most beautiful when it is in blossom. He who plucks off the flower, while marring the beauty of the plant, destroys the fruit forever. —*Abridged from the Journal of the Society of Arts.*

## RECENT SCIENCE.

By PRINCE KROPOTKIN.

I.

DURING the last thirty years the data of meteorology have been accumulated with a very great rapidity, and the chief desideratum of the moment is, to construct with these data such a general theory of the circulation of the atmosphere as would embody the distribution of heat, pressure, moisture, and winds over the surface of the earth, and represent them as consequences of well-established mechanical laws. The old provisory hypothesis of atmospheric circulation, advocated by Hadley in 1735, and further elaborated by Dove in our century, can be held no more, and a new theory has become of absolute necessity.

We all have learned Dove's theory at school, even though we often found it difficult to understand. The air, greatly heated on or near the equator, rises in the same way as it rises in the summer over a sunburned plain. On reaching the higher strata of the atmosphere it flows toward the poles, but, owing to the speed of rotation which it has acquired in the lower latitudes, it is deflected—to consider the northern hemisphere only—to the right, and blows in the upper strata as a current from the southwest. To compensate this flow, air rushes on the earth's surface toward the equator, and as it also is deflected from its course by the same inertia of rotation, it appears in the tropics as a trade wind blowing from the northeast. However, the upper warm current does not flow all the way to the pole in the upper regions; it is gradually cooled down, and in about the thirtieth degree of latitude it begins to descend to the earth's surface, where it meets with the cold polar current. A struggle between the two winds ensues, and it lasts until they make a temporary peace by blowing side by side, or one above the other, the struggle giving origin to storms and to changes of wind which are fully analyzed in Dove's theory. A rope without end rolling over two pulleys, one of which lies horizontally near the equator, and the other stands upright in

higher latitudes—such was the simplest expression of Dove's theory given in text-books.*

Under this provisory hypothesis meteorology made an immense progress, and some five-and-thirty years ago, Leverrier in France, and Fitzroy in England, ventured for the first time to foretell weather twenty-four hours in advance, or at least to send out warnings as to the coming storms. This bold step brought meteorologists face to face with a quite new problem. From the air pressure, the temperature, the moisture, and the winds observed at a certain hour of the day at various spots and telegraphed to a central station, they had to infer the next probable state of weather. So, leaving aside the great problems of atmospheric circulation, they directed their attention to the changes of weather rather than to the causes of the changes.† For this purpose purely empirical laws were of great value. When the meteorologist saw on a weather chart a region of low atmospheric pressure, with winds blowing in spirals round and toward its center, he named it, by analogy with real cyclones, a "cyclonic disturbance" or a "cyclone," giving the name of "anticyclone" to the region of high atmospheric pressure—and he studied the tracks of both disturbances in their advance across the oceans and the continents. He did not inquire for the moment into the causes of the disturbances; he took them as facts, and, following Buys Ballot's law, he said that the wind will blow as a rule from the region of high barometic pressure (the anticyclone) to the region of low pressure (the cyclone), with a certain deflection to the right or to the left. Immense researches were made to study the routes followed by the centers of barometrical minima, and we now have splendid atlases showing the normal tracks of cyclones across the Atlantic Ocean, over Europe and the States, in Japan, in the Indian Ocean, and so on, at various seasons of the year.‡ With these empirical data meteorologists attained such a perfection in their weather forecasts that in five cases out of six their previsions are now correct, while the coming gales are even foretold with a still greater accuracy.

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* E. E. Schmid, Lehrbuch der Meteorologie, Leipsic, 1860, p. 568.

† See W. Bezold's short sketch of meteorological progress in Sitzungsberichte der Berliner Akademie der Wissenschaften, 1890, ii, 1295, *sq.*

‡ Besides the earlier works of Ley (Laws of the Winds prevailing in Western Europe, Part I, 1872) and Köppen (Wissenschaftliche Ergebnisse aus der monatlichen Uebersichten des Wetters, 1873–'78), we have now the splendid work of W. J. Van Bebber, which embodies the tracks of all cyclones in Europe for the last fifteen years (Die Zugstrassen der barometrischen Minima, für 1875–'90), the researches of Blanford, S. E. Hill, and Elliot in the Indian Meteorological Memoirs and Cyclone Memoirs, Part IV (published by the Meteorological Department of India), the work of E. Knipping for Japan, in Annual Meteorological Report for 1890, Part II, Appendix, and several excellent works for Russia.

However, the very progress achieved demonstrated the necessity of a more thorough knowledge of the too much neglected upper currents of the atmosphere. In Dove's scheme, the upper equatorial current, after part of it had been sent back to the equator, was entirely abandoned to itself, to make its way as best it could against the opposed polar winds; but the existence of a strong, nearly permanent, and relatively warm upper wind blowing toward the east in our latitudes—which was only probable thirty years ago *—became more and more evident, especially since the movements of clouds began to be systematically studied and observatories were erected on high mountains; and this wind remained unexplained in Dove's theory, while in Maury's scheme of atmospheric circulation, which is still in great vogue in our schools, there was even substituted for it a current in an opposite direction, which does not exist, and which Maury himself could not account for.† An entire revision of the subject was thus necessary, and this revision has been done by the American meteorologist Ferrel, in a series of elaborate works which are only now beginning to receive from meteorologists the attention they fully deserve.

Ferrel's theory is based upon considerations as to the laws of motion of liquids and gases of different densities. If the whole atmosphere were equally heated in all its parts, and at full rest, the air would be disposed in horizontal layers, of greater density at the bottom, and of decreasing density toward the top. Considering some part only of the atmosphere, from pole to equator, and neglecting the curved surface of the earth, we should thus have something analogous to a trough filled with layers of different liquids. If one end of the trough were now warmed, and the other end were cooled, the layers would be horizontal no more.

* Observations in Siberia—namely, at the graphite works on Mount Alibert, at a height of eight thousand feet (52° north latitude)—were especially conclusive. Alibert's observations, buried in the Russian *Trudy* of the Siberian expedition, proved the existence of a nearly permanent west and west-northwest wind on the top of the peak, and they showed at the same time that the average yearly temperature on the top of the peak was by some fourteen to eighteen Fahrenheit degrees higher than it otherwise ought to be. When I visited the then abandoned mine in 1864, and saw the peak dominating all surrounding mountains, and could judge of the force of the west wind from the immense works accomplished to protect the road which was traced on the western side of the peak, I could not refrain from explaining the extraordinary great height of the snow-line in east Siberia by the existence of a relatively warm equatorial current blowing with a great force at a height of from eight to ten thousand feet in the latitude of 52° north. Later on the observations which I brought from the Voznesensk mine (60° north, altitude twenty-six hundred and twenty feet) induced my friend Ferd. Müller, who calculated those observations, to conclude that in higher latitudes the same current descends still lower to the earth's surface, and still maintains some of its initial warmth.

† See James Thomson's paper On the Grand Currents of the Atmosphere, in Philosophical Transactions, A. 1892, p. 671.

They would be inclined, but in two different ways: the lower ones would be inclined toward the warm part, while in the upper layers the inclination would be the reverse. A full circuit of the lighter liquids flowing one way on the surface, and of heavier liquids flowing the other way on the bottom, would thus be established. The same would happen in our atmosphere with the lighter warm currents and the heavier cold currents if the earth had no rotation on its axis. But it rotates—the solid globe as well as its gaseous envelope—and this modifies the whole circulation. The air which flows from the equator to the poles maintains, not its velocity of rotation, as has been hitherto taught, but its energy of rotation, which means that it obeys the law of preservation of areas; therefore, when it is transported from the equator to a higher latitude it is endowed (in the northern hemisphere) with a much greater easterly velocity than if it simply maintained its speed of rotation. On the other side, the air which is flowing from the higher latitudes toward the equator also obeys the same law and acquires a westward velocity, but much smaller than the eastward velocity of the former; this is why the west winds have such a preponderance in our latitudes.* Moreover, in virtue of the centrifugal force, all masses of air moving in *any* direction—not only north or south, but also due west or east—are also deflected to the right in the northern hemisphere, and to the left in the southern hemisphere.† Consequently the air flows in great spirals toward the poles, both in the upper strata of the atmosphere and on the earth's surface beyond the thirtieth degree of latitude; while the return current blows at nearly right angles to the above spirals, in the middle strata as also on the earth's surface, in a zone comprised between the parallels 30° north and 30° south.‡

Such are, very briefly stated, the leading features of the theory which Ferrel laboriously worked out during the last thirty years, submitting all its parts to the test of both observation and mathematical analysis. By the end of his life (he died in 1891) he embodied his theory in a well-written and suggestive popular work,

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* Full tables giving the eastward (or westward) velocities for each latitude, under the two different hypotheses, have been calculated for the Meteorologische Zeitung, 1890, pp. 399 and 420.

† Ferrel seems not to have been aware that the same had been demonstrated by R. Lenz for rivers (about the year 1870), in a discussion of Baer's law, applied to the Amu River, in the Mémoires of the St. Petersburg Academy.

‡ William Ferrel, A Popular Treatise on Winds, comprising the General Motion of the Atmosphere, Monsoons, Cyclones, Tornadoes, Waterspouts, Hailstorms, etc. New York: Wiley, 1889. See also analysis of it by W. M. Davis (in Science, xv, p. 142; translated in Meteorologische Zeitung, 1890; Literaturbericht, p. 41), who gave the best diagram of circulation according to Ferrel's theory, and by H. F. Blanford in Nature, xli, 124. A full bibliography of Ferrel's works was given after his death in the American Meteorological Journal, October, 1891.

which fully deserves being widely known. All taken, his views so well agree with the facts relative to the movements of the atmosphere, and they give such a sound method for further investigation, that they are sure to become for some years to come the leading theory of meteorology. They already have given a strong impulse to theoretical research, and have created a whole literature in Austria and Germany.*

Another theory of the general circulation of the atmosphere which is also awakening a good deal of interest among physical geographers was propounded in 1886 by Werner Siemens, and further developed by him in 1890.† Siemens did not consider that air might flow down the density surfaces, as supposed by Ferrel and Helmholtz, and admitted by many meteorologists, and he maintained that the source of the energy required for all disturbances of equilibrium in the atmosphere must be looked for in the unequal heating of its different strata by the sun, and in the unequal loss of heat through radiation in space. From these considerations he inferred the existence of an ascending current in the equatorial belt, an upper warm current, and a cold polar current. As to the eastward and westward directions of these currents, he made the very just remark that the energy of rotation of the whole atmosphere must remain constant and unchanged, even though masses of air move from one latitude to

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* Roth has already abandoned the mathematical objections he had raised against Ferrel's theory in the Wochenschrift für Astronomie, 1888. The objections raised by Teisserenc du Bort and Supan against the "density surfaces" have been answered by Prof. Davis in Science, and are not shared by the most prominent meteorologists. And the mathematical analysis of Prof. Waldo, Sprung (the author of the well-known Treatise of Meteorology), M. Möller, and Pernter has further confirmed the accuracy of the theory. So also Hildebrandsson's observations of upper clouds (Annuaire de la Société météorologique de France, xxxix, 338), Teisserenc du Bort's high-level isobars, and Guaran de Trommelin's researches relative to coast winds. The transport of the Krakatoa dust and Abercromby's observations of clouds having rendered the existence of an upper east current very probable on the equator, Pernter has mathematically deduced from Ferrel's theory the existence of such a current in a belt 4° 45′ wide on both sides of the equator, and he therefore has withdrawn the restrictions he had previously made in a lecture (published in Nature, 1892, xlv, 593) in favor of Siemens's views. It must be added that the idea of three superposed currents blowing in spirals may have been suggested to Ferrel by a communication of James Thomson to the British Association in 1857. Such was, at least, the claim raised and developed at some length by the Glasgow professor before the Royal Society in a Bakerian lecture, now published in the Transactions (A. 1892, pp. 653–685). Though Thomson's paper was never published, and only given in a very short abstract without a diagram (the diagram in the Transactions is now published for the first time), the few lines in which his theory was stated (British Association Reports, Dublin, 1857, pp. 38, 39) contained the idea clearly expressed. It is certainly a matter of great regret that James Thomson has not returned to this subject.

† Ueber die Erhaltung der Kraft im Luftmeere, in Sitzungsberichte der Berliner Akademie der Wissenschaften, March, 1886, p. 261; Ueber das allgemeine Windsystem der Erde, in same publication, 1890, ii, p. 629.

another. The velocity of rotation of the atmosphere in tropical latitudes must therefore lag behind the rotation of the earth, and it must outstrip it in higher latitudes, mathematical calculation proving that the thirty-fifth parallel is, in both hemispheres, the line of division between the two. The general system of air circulation deduced from these principles is very similar in its results to the system of Ferrel; but the interest and importance of Siemens's views lie elsewhere. His memoirs were an appeal and an attempt to apply the principles of thermodynamics to the aërial currents, and they have opened the way for a series of important researches, which, however, are not yet sufficiently advanced to be discussed in these pages.

And, finally, a third new point of view has been introduced into the same discussions by Helmholtz. Sitting one day by the seaside, and observing how wind blows on the surface of the sea by sudden gushes, how it originates waves, and how they grow when wind blows with an increasing force, Helmholtz came to consider what would happen with two air currents blowing one above the other in different directions. A system of air waves, he concluded, must arise in this case, in the same way as they are formed on the sea. The upper current, if it is inclined toward the earth's surface (as is often the case), must originate in the lower current immense aërial waves rolling at a great speed. We do not generally see them, but when the lower current is so much saturated with moisture that clouds are formed in it, we do see a system of wavelike parallel clouds, which often extend over wide parts of the sky. To calculate the sizes of the waves in different cases is extremely difficult, if not impossible; but by taking some simpler cases Helmholtz and Oberbeck showed that when the waves on the sea attain lengths of from sixteen to thirty-three feet, the air waves must attain lengths of from ten to twenty miles, and a proportional depth. Such waves would make the wind blow on the earth's surface in rhythmical gushes, which we all know, and they also would more thoroughly mix together the superposed strata, dissipating the energy stored in strong currents. These views are so correct that they undoubtedly will throw some new light, as they already begin to do, upon the theory of cyclones.*

At the same time, Bezold is now endeavoring to reconstruct meteorology from the point of view of thermodynamics; † and the well-known Austrian meteorologist, J. Hann, whose work is

* H. Helmholtz, Zur Theorie von Wind und Wetter, and Die Energie der Wogen und des Windes, in the Sitzungsberichte of the Berlin Academy, 1889, ii, and 1890, ii. Oberbeck's calculations of the waves are given in the Meteorologische Zeitung, 1890, p. 81.

† Zur Thermodynamik der Atmosphäre, in Sitzungsberichte of the Berlin Academy of Sciences, 1888, p. 485; same year, p. 1189; 1890, p. 355; and 1892, p. 279.

exciting just now a great deal of interest, has openly broken with the old theory as regards the origin of cyclones and anticyclones.* From observations made for several years in succession on the top of the Sonnblick—a peak twelve thousand feet high, of the Tyrolese Alps—as well as from observations made on several high-level stations, he has concluded that a cyclone can *not* be due to a local heating of the earth's surface and to an ascending current of warm air provoked by this cause, just as an anticyclone can not be due to a local cooling of the earth's surface, and to a consequent condensation of the air. Contrary to the previsions of the meteorologists, the ascending column of air within a cyclone, up to a height of some ten thousand feet, is not warmer than the surrounding air; it is *cooler* within the cyclone, and its upward motion thus can not be due to its temperature. So also in an anticyclone the descending current of air is *warmer* than it is under normal conditions, and its downward motion must be due to some other cause than an increase of density resulting from a lowering of its temperature. The decrease of pressure in the one case, and its increase in the other, thus can not be caused by differences of heating or cooling of the lower strata; and both cyclones and anticyclones must be considered as parts of the general circulation of the atmosphere, such as it was conceived by Ferrel.†

Such a deep modification of the current views, though supported to a great extent by weighty evidence, will obviously not be accepted without opposition; but it is already making its way, and certainly will exercise a deep influence on the further development of meteorology.

Abandoning now the domain of theoretical investigation, I must mention a work—also a life's work—which may safely be placed side by side with the best achievements in theory. I mean the beautiful charts of Mr. Buchan, representing the distribution of pressure, temperature, and winds over the surface of the globe, embodied in the last volume of the Challenger Expedition Reports. When Mr. Buchan published twenty-three years ago his first maps of monthly isobars and prevailing winds, they were quite a revelation, even though the data upon which they were based were very incomplete at that time.‡ But better data have

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* Das Luftdruckmaximum vom November 1889, in Denkschrift der Wiener Akademie der Wissenschaften, 1890, Bd. lvii, p. 401. Bemerkungen über die Temperatur der Cyclonen und Anticyclonen, in Meteorologische Zeitschrift, 1890, p. 328.

† See the discussion of this subject between Hazen and J. Hann in Science, 1890, xv, 382–384, and Meteorologische Zeitschrift, 1890, p. 328.

‡ To trace the isobars, or lines of equal atmospheric pressure, reduced to the sea-level, the real altitude of each meteorological observatory must be known from direct geometrical levelings; but in 1869 the altitude of not one single station in Siberia, central Asia, or even the Urals was known. A leveling across Siberia, as far as Lake Baikal, has been

been collected since, and in the hands of Mr. Buchan they have undergone such a careful and able analysis that the Challenger Reports charts may be taken as the best reliable representation of the winds, the temperatures, and the pressure in the lowest strata of the atmosphere, as well as the surest basis for further generalizations.* The theories which have been mentioned in the preceding pages give the grand lines of atmospheric circulation; on Buchan's maps we see how the grand lines are modified in the lowest strata by the distribution of land and sea, and the unequal heating or cooling of continents and oceans. The leading features indicated by theory are still maintained, and they become even still more apparent if we consult isobars traced for a certain height, like those of Teisserenc de Bort; but the immense plateaus of East Asia and North America act in winter as colossal refrigerators, where cold and heavy air accumulates, to flow down in all directions toward the lowlands. We see also how in July the air is heated in the lower lands of northwest India, in the corner between the Afghanistan and the Thibet plateau, how pressure is lowered there by the ascending current, and how winds blow toward this region of lowered pressure. We see more than that: on looking on the maps it strikes the eye how the moisture or the dryness of the climate is dependent upon the distribution of pressure, and how the dry anticyclonic winds make barren deserts of parts of North and South America, of Africa, and central Asia, and how they will continue to dry the lakes and the rivers of these regions and occasion total failures of crops so long as that distribution of pressure lasts on the globe, and man has not yet learned to eschew its effects by getting water from the depths of the earth. The life of the globe during the present period is written on these splendid charts.—*Nineteenth Century.*

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M. Thoraddsen, in the narrative of his travels in Iceland, observes a peculiar feature of the oases at the foot of Mount Hecla. These oases are subject to constant displacement by the violent sandstorms which are common. On the windward side all vegetation is gradually destroyed, while on the other side grass takes root, and in a wonderfully short time the level and sterile surfaces are converted into good pasture lands.

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made since, Mr. Buchan's isobars having been one of our best arguments to press the necessity of the leveling. But Mr. Buchan may not be aware that the leveling beyond the ninetieth degree of longitude is now considered by Russian geodesists as utterly unreliable; it is supposed to contain some substantial error, so that a new leveling between Krasnoyarsk and Lake Baikal is insisted upon. The incertitude in the isobars on an immense space in northeast Asia resulting from this cause may attain as much as one or, perhaps, even three tenths of an inch.

* An excellent *résumé* of the whole work and its results in a popular form has been published by Buchan himself in the Proceedings of the Geographical Society, March, 1891.

## IS CRIME INCREASING?

THE question whether crime is increasing or decreasing in England and Wales has been the subject of an interesting discussion in The Nineteenth Century between the Rev. William Douglas Morrison, chaplain to the prison at Wandsworth, and Sir Edmund F. Du Cane. Mr. Morrison remarks upon the incertitude and diversity of opinion prevailing on the subject as something which it is desirable to clear away, and attributes the perplexity of the public mind in the matter, in the main, to the erratic and haphazard manner in which criminal statistics are frequently handled. One of the most obvious mistakes, and yet one which is frequently committed in dealing with questions of crime, is to draw sweeping inferences from the criminal statistics of a single year, or even of a short series of years. "It has to be remembered that criminal returns are largely affected by the fluctuating conditions of social existence, some of the more important of these being the rise or decay of political or industrial agitation, the ebb and flow of commercial prosperity, and, more rarely, the emotions aroused among the population by a state of war. In order as much as possible to neutralize the disturbing effect of these inconstant social factors, it is essential that all statistics relating to crime on which it is proposed to build any general conclusions should cover a decade at the least, and unless this principle is adhered to misleading ideas are almost certain to arise." Sir Edmund Du Cane thinks that even ten years are hardly a long enough period on which to base correct conclusions.

In Mr. Morrison's investigation of the subject three methods of treatment present themselves for consideration. The total number of offenses as reported to the police may be taken as a criterion; or the number of cases tried, both summarily and by indictment; or the total number of convictions. In order to appreciate the movement of crime in all its various aspects, each of these three methods is more or less necessary.

The returns of the yearly average of trials in the three decades 1868 to 1889 reveal an increase from 466,087 in the first decade to 701,060 in the third, satisfying Mr. Morrison that the total volume of crime has increased very materially within the period. Among the causes which have fostered this growth, he assigns an important place to the development of social legislation. Offenses against the Elementary Education Acts alone, he says, "have furnished considerably more than half a million cases, and other acts of a like character have produced similar results. But the growth of offenses arising from a continuous widening of the sphere of legislative effort is to some extent counterbalanced by

the abolition in recent years of several old penal laws, as well as by the greater reluctance of the police to set the law in motion against trivial offenders. . . . Offenses may be growing, but the population may be increasing still faster; the question, therefore, requires to be considered, to what extent the total number of cases tried is keeping pace with the general growth of the community. Basing our calculations upon the estimated population at each decade, it comes out that in 1860–'69 one case was tried annually for every forty-four of the inhabitants of England and Wales; in 1870–'79, one for every thirty-seven inhabitants; and in 1880–'89, one for every thirty-eight. According to these statistics, the proportion of crime to the population has remained almost the same for the last two decades; but, if the last two decades are compared with the first, the growth of crime has outstripped the growth of population."

The question whether crime is increasing in seriousness along with its expansion in volume may be answered best by an analysis of the number and nature of the indictable offenses brought up for trial during the three decades. The figures disclose a continuous decrease; but opposed to this is the fact that the cases of offenses against property without violence, constituting two thirds of the whole number tried in the first decade, were more usually dealt with summarily during the two subsequent decades. For arriving at a more accurate estimate of the serious crimes committed in the first decade, Mr. Morrison selects as a type murder, concerning which no material change in public feeling or judicial procedure has taken place within the last thirty years. The figures—126 in the first decade to 153 in the third—show that this, the most serious of all crimes, has steadily increased within the last three decades, and that in proportion to the growth of population it was nearly as common in the last decade as in the first. The author believes, therefore, that the apparent decrease in indictable offenses is attributable to a change of criminal procedure rather than to an actual decrease of serious crime. Even after the Summary Jurisdiction Act was passed, by which a large number of cases were taken out of the indictable list, every form of serious crime appears to have relatively increased. Large increases in the average of commitments to prison, the extension of juvenile and reformatory schools, and the rapid and uninterrupted augmentation of the police force, are further adduced as pointing to the conclusion that "crime during the last thirty years, for which we possess official returns, has not decreased in gravity, and has been steadily developing in magnitude."

The explanation of this supposed increase is sought in the concentration of men in large cities and industrial centers.

Sir Edmund Du Cane criticises Mr. Morrison's methods, fig-

ures, and conclusions unsparingly, and declares as the best opinion he has been able to form on a review of all the facts, and from the expressions of persons whose practical connection with the subject gives weight to their views, that crime is decreasing. He cites the returns of the prison population since 1877 as showing a continuous annual decrease, which none of the explanations offered adequately account for except those which ascribe it to the depression of trade cutting off the supply of money for drinking with, or to the growing dislike of a certain class of criminals for life in prison—both of which imply a decrease of crime. He ascribes the decrease to Christian philanthropy, which he says has never attained a higher development than now, when it is perhaps one of the principal features of the present stage of civilization. It "has led to an entirely new way of dealing with crime—namely, by prevention instead of by punishment; and one of the principal results of this philanthropic idea is the establishment of industrial schools, in which young persons who seem likely to fall into crime and to develop into adult criminals may be trained into a better way and made into useful members of society.

"It has led to those movements for providing better dwellings, and otherwise raising the condition of those who are sometimes called 'the disinherited,' sometimes 'the submerged,' which help to remove temptations to crime, and purify the atmosphere in which those who may develop into criminals have been compelled to live.

"It is perhaps one of the most curious features in the proof offered of the increase of crime that the adoption and development of the very means by which it is diminished are cited as corroborations of the doctrine that it has increased—among them being the increase in the number of juveniles committed to industrial schools. To show this we are given the number of those committed to 'reformatories and industrial schools' added together. The reformatories are penal and reformatory institutions for young persons convicted of crime, and correspond, therefore, to prisons. The industrial schools, on the other hand, are preventive institutions for children who have not been convicted, but might fall into crime for want of proper care and training. To mix the two together obviously obscures the facts, and the more thoroughly because the committals to reformatories have decreased during the last ten years, so that the increase in the united numbers is solely due to the development of the distinctly preventive institutions, to which there is little doubt the decrease in crime and criminals is largely due, and which are the product of the Christian civilization of which Rousseau thought so little. In fact, mixing the two together is as if an increased prevalence of small-pox was proved by adding together the num-

ber of people who developed the disease and the number who were vaccinated to guard against it. Further than this, the figures given in the article [Mr. Morrison's] compare the three decades beginning in 1860, 1870, and 1880, and show, what is true enough, that the number of inmates of these two classes of institutions has increased in each ten years; but this does not show an increase of convicted or even of potential criminals, but only reminds us that there were comparatively few such schools until the great development of these institutions took place after the Reformatory and Industrial Schools Acts were passed, in 1866, for the purpose of encouraging them, and that advantage has been taken of them with still greater vigor in connection with the Education Acts passed in and since 1870.

"In a similar way the increase in the police force is cited as a proof of the increase of crime. If this view were sound, we should expect to find that when there was no police force at all it was because there was no crime—a paradox which, perhaps, it is not necessary to spend time in refuting. Many years ago no traveler could cross Hounslow Heath, Wimbledon Common, or similar desolate approaches to the metropolis, without a good chance of being robbed. Hanging those who were caught did not check this inconvenience; but at last Sir John Fielding hit upon the idea that it might be prevented, and established the armed horse patrol, which soon put a check on the highwaymen. Their appointment was no sign that highway robbing had increased; it was only a better mode of preventing it. Another most potent mode of preventing crime is by making detection more certain. . . . An increase in the police force, with a view to their greater preventive efficiency, is no more a sign that crime has increased than an increase in the amount spent in drainage and water supply, when towns and localities become alive to their advantage, is a proof of increased unhealthiness in places which have adopted such preventive precautions. If an inquiry into the health of a town was to assume that the increased activity of drainage was a sign of increasing bad health, and was altogether to ignore and pass over the evidence afforded by the improved death-rate and the opinion of the medical men of the town, it would be precisely similar to taking the increased activity in progressive development of these preventive institutions as a sign of increase of crime, omitting altogether any investigation into their effect on the number of the criminal classes or disorderly houses, and ignoring the direct testimony of the police, who must know how these matters stand."

A large proportion of the duties of the police, moreover, have nothing to do with crime. The mere collection of large numbers of people together makes a police necessary without any reference to the crime they actually commit.

The police every year furnish a return of the number of the criminal classes. A comparison of the numbers given in these returns affords what seems to be irresistible testimony of an immense improvement. Since the year 1867–'68 the decrease in their number has been practically continuous. Is it conceivable that, while the criminal classes have diminished in this manner, crime has increased?

The direct testimony of the police themselves may be cited. The commissioner of police of the metropolis adduces facts and figures from which it "appears that there was greater security for person and property in the metropolis during 1890 than in any previous year included in the statistical returns"; and this, notwithstanding the increasing growth of the city at the rate of a million a decade, makes it continually more difficult for the police to deal with crime. The chief constable of Liverpool says that "never since the first publication of returns of crime in Liverpool (i. e., since 1857) have the statistics disclosed so small an amount of crime or so large a success in making criminals amenable to justice as those for the year ended the 29th of September, 1891." The report for 1892 is to the same effect, except that crimes of violence had slightly increased.

Mr. Grosvenor, of the Home Office, in a paper on The Abatement of Crime, read to the Statistical Society in 1890, spoke of the abatement having taken place in nearly all classes of crime during the last twenty years; of the "reduction in the number of known thieves and other suspected persons at large, as well as of houses of bad character which they frequent," and of the extraordinary diminution in the number of receivers of stolen goods. Adding to this the fact of the great increase in the population of the country, "we must admit," he says, "that the many agencies enlisted for the purpose of diminishing the number of criminals have been most successfully applied, and the result can not fail to afford the utmost satisfaction and encouragement to all who are anxious for the improved moral and physical advancement of our nation."

Before considering the figures that measure the fluctuation in the actual crimes, Sir Edmund Du Cane tries to define what is meant by the word crime as used in the discussion. One studying the tables with a view to ascertaining the fluctuations in crime, looking merely at the total number at the foot of them, would probably conclude that the total volume of crime has increased very materially, for the tables show apparently a very considerable increase; "but if we look a little more closely at these totals of which the figures are made up, we see that a very large proportion of these offenses are not 'crimes' at all, as the word is ordinarily understood. For instance, offenses against the Education

Acts could not be committed before 1870, but they count for 96,601 in the latter year. Few people, however, would say that 'crime' was increasing and civilization demoralizing us because we now compel parents to send their children to school, and hale before the magistrates those who fail to do so, not having yet been accustomed to accept the new law. Offenses against local acts and borough by-laws, which are not 'crimes,' have in the same time increased from 35,681 to 59,108; begging and other offenses against the vagrant acts, from 41,780 to 46,019; offenses against the highway and similar acts, from 29,837 to 32,889. If the efforts that are being made to make it a penal offense to work more than eight hours a day are successful, we might expect to find several hundred thousand added to the number of offenses brought before the magistrates, but nobody would consider this a proof of increase of 'crime.' To find out, therefore, whether crime has increased or decreased, it is necessary to extract from the mass of figures those which really illustrate this point. The judicial statistics have provided an excellent classified analysis of the offenses in which those that consist of breaches of the laws for the protection of the person or property are set forth in five classes, which constitute substantially what people have in their minds when they speak of an increase or decrease of crime. The tables distinguish between offenses summarily dealt with and those not so treated as indictable offenses. Offenses of the latter class only are included in the classification. These consist of offenses against the person, including assaults; offenses against property, with violence; offenses against property, without violence; malicious offenses against property; and forgery and offenses against the currency." The tables, as summarized by the author, afford clear evidence of a continuous decrease in the number of crimes committed both indictable and summary, which is fatal to the theory of an inevitable increase.

Such results, Sir Edmund Du Cane observes, should be no matter of surprise, as they have, to all appearances, followed the preventive measures taken in order to effect them, among which are particularly specified the establishment of institutions to guard young people from falling into crime. This is further corroborated by the decrease in the number of first convictions, and the diminution in the number of young persons (under sixteen years of age) committed to prison (which includes all those sent to reformatories).

The author makes no reference in his review to punishment as in any degree the cause of the decrease in crime which he sets forth, "though," he says in his concluding paragraph, "I well remember that, when crime was increasing, it was at once set down to the prison system. I will not endeavor to appraise the

share which punishment has in the decrease of crime, but will repeat that in my opinion prevention is far and away better than any possible cure, and that next to prevention stands certainty of detection and of bringing to justice. Punishment, then. naturally comes into operation to serve as a warning and a deterrent to the wavering, and to the detected culprit a chastening experience, that should always be accompanied by influences calculated to reform."

## SKETCH OF CHARLES A. JOY.

By MARCUS BENJAMIN, Ph. D.

IN tracing the growth of science in this country it is interesting to observe how its development may be followed in the biographies of its leaders; thus, many of our scientists received their first inspiration from the elder Silliman, while those of a later date acquired their great fondness for the life-work to which they devoted themselves from Louis Agassiz. From the leaders the growth of science passed to the institutions with which originally they were connected; then broadening, it located itself permanently with those having the best instruction. In a less degree. but equally true, is such the case in our cities. The story of the development of science in New York city can be acquired almost entirely by reading the lives of such men as Samuel Latham Mitchell, James Renwick, John Torrey, John William Draper. and John Strong Newberry. From these men its growth passed in time to such institutions as Columbia College, the New York Academy of Science, the University of the City of New York. and the Columbia College School of Mines.

In the development of chemistry in this city CHARLES ARAD JOY took a prominent part; and if, perhaps, his name is not as well known as some others, it must be attributed to the long years of retirement—many of which were years of suffering—that he passed in Europe and in his country home prior to his recent death.

Prof. Joy was born in Ludlowville, Tompkins County, New York, on October 8, 1823. His father was a well-known merchant. but a fondness for literary pursuits seems to have been the habit of the family. An elder brother became distinguished as an able physician, and a sister married an eminent clergyman. With his brother he studied at excellent preparatory schools in Ovid, N. Y.. and in Lenox, Mass., and then was sent to Union College, where he was graduated in 1844. Choosing law as his profession, he entered Harvard, where he graduated in course at its law department in 1847, receiving the degree of LL. B. Meanwhile he had

acquired a fondness for science. The beginnings of the application of electricity to every-day life were manifesting themselves in the development of telegraphy under the direction of Samuel Finley Breese Morse. The wonderful richness of the Lake Superior region in mineral wealth had just been made known and the first copper mines opened, revealing almost pure metallic copper to the astounded world. It was also while Joy was a student at Harvard that Louis Agassiz gave his first course of lectures before the Lowell Institute in Boston, and it may have been, indeed perhaps was, these lectures that led him to abandon the following of a legal career in order to become a scientist. Moreover, he was happy at this time in meeting Charles T. Jackson, one of the most interesting characters in the history of American chemistry, in whose laboratory, which was early opened to private students, the original researches on the anæsthetic properties of ether are said to have been made.

In 1847 Dr. Jackson was commissioned by Congress to survey the mineral lands of Michigan, and promptly on finishing his course at the law school Joy was invited to become a member of the party, and continued with this expedition until the completion of its work. He then studied for a time in Dr. Jackson's laboratory; but realizing the impossibility of acquiring a thorough training in chemistry in this country, he turned his steps toward the Mecca of that science, and for two years studied in Germany, first under Heinrich Rose in Berlin and then under Friedrich Wöhler in Göttingen, where in 1852 he took the degree of Doctor of Philosophy. For an inaugural thesis the difficult subject of the combination of alcohol radicals with selenium was assigned to him, while at an adjoining desk a similar research pertaining to the tellurium compounds was being carried on by Prof. John W. Mallett, now of the University of Virginia. In after years Prof. Joy frequently related to his classes how that, owing to the offensive odors generated in the preparation of the selenium and tellurium compounds, he and his fellow-student, Mallett, were often the only two who remained at work. These researches were among the earliest contributions to a class of alcohol radicals combined with a metallic base that appeared in chemical literature. After receiving his degree at Göttingen he spent some time at the Sorbonne in Paris, where the brilliant Dumas, then in his prime, lectured on chemistry.

With a scientific training seldom equaled by any young man he returned to America, and was promptly called to the chair of Chemistry in Union College. This place he then held for four years, during part of which time he was assisted by Charles F. Chandler, who later became Professor of Analytical and Applied Chemistry in the School of Mines of Columbia College, and, sub-

sequent to the resignation of Prof. Joy, his successor in the chair of Chemistry in Union.

In 1857 Columbia College moved to its present site in Madison Avenue, between Forty-ninth and Fiftieth Streets, and the chair of Natural and Experimental Philosophy and Chemistry, then held by Prof. Richard McCulloh, was divided so as to form the chair of Mechanics and Physics, which was retained by Prof. McCulloh, while a call to that of Chemistry was given to Prof. Joy. It is perhaps worth recording that the only other candidate suggested for the new chair was Dr. Wolcott Gibbs, an alumnus of Columbia, in the class of 1841, then Professor of Physics and Chemistry at the College of the City of New York, whence, in 1863, he was called to the Rumford chair in the Lawrence Scientific School of Harvard.

With the prestige of a splendid education, a successful career at Union, and with fine social qualities, Prof. Joy was indeed well fitted to advance the course of chemistry in Columbia. Almost at once he founded in connection with his department a School of Chemistry, designed to give a complete professional education in chemistry to such as desired it. In the prospectus he wrote, "The laboratory is furnished with the best modern appliances for acquiring a thorough knowledge of chemistry and the applications of the science to agriculture and the arts." Among those who availed themselves of this instruction were Major Clarence S. Brown, Captain William Jay, and other officers of the United States army; also such mining engineers as George William Maynard, Edward M. Pell, and others; while classed as chemists were Julius H. Tieman, Peter C. Tieman, and William J. Youmans. The success of this experiment made it easily possible, in 1863, to interest the trustees of Columbia College in accepting the plan proposed by Thomas Egleston, Jr., for the establishment of a School of Mines. Prof. Joy was a pronounced advocate of this undertaking from the outset. He was urged to assume charge of the department of chemistry in the new school, but this he declined, and recommended that his assistant at Union, Prof. Charles F. Chandler, be called to organize the department. This advice was at once favorably acted on by the trustees of Columbia College, and Prof. Chandler was given the chair of Analytical and Applied Chemistry, with charge of the laboratories. Although his duties in the academic department were already quite onerous, Prof. Joy promptly volunteered his services as lecturer, and in the first catalogue of the School of Mines his name appears as in charge of organic chemistry. Later, when the regular faculty was organized, he was made Professor of General Chemistry, and so continued until his retirement in 1877; also in the meanwhile he remained at the head of the chemical department of the college proper.

The atmosphere of a large city is not conducive to much original work in science, and especially is this the case in New York city. Things of a more practical nature force themselves upon the attention of a scientist, and his opinion is in constant demand. In consequence, we find in the American Contributions to Chemistry but two papers devoted to original research contributed by Prof. Joy during the time of his connection with Columbia College. They are On Glucinum and its Compounds (1863), and Analysis of a Meteorite from Chili (1864), both of which were published in the American Journal of Science. Several of the analyses of minerals that appeared in Dana's System of Mineralogy by him were also made at this time. This meager record is readily explained by the fact that Prof. Joy's literary inclination was promptly taken advantage of by the editors of prominent periodicals, and articles from his skillful pen were constantly in demand. He was a frequent contributor to the Scientific American, and every week prepared columns of notes for Frank Leslie's periodicals, reviewing all of their foreign scientific exchanges for them. For many years he edited the Journal of Applied Chemistry, published in New York, and also wrote most of the articles on chemistry in Appletons' American Cyclopædia.

Prof. Joy was naturally prominent in numerous organizations, chiefly, however, in those of a scientific character. He held the chairmanship of the Polytechnic Association of the American Institute; he was also President of the American Photographic Society. During 1866–'67 he was President of the Lyceum of Natural History, now the Academy of Science, from which place he gracefully and generously retired after a brief service in order to afford an opportunity to Dr. John S. Newberry to be introduced to the scientific circles of the metropolis. In 1874, when the American chemists gathered at the grave of Priestley, in Northumberland, Pa., and an organization was effected to celebrate the Centennial of Chemistry, Prof. Joy was chosen one of the vice-presidents. He was a Fellow of the American Association for the Advancement of Science, and for a time was Foreign Secretary of the American Geographical Society; he was likewise an enthusiastic member of the Century Association. It is but fair also to record his active interest in various charitable societies, and he was a member of the Protestant Episcopal Church.

Among the many interesting experiences of his life none perhaps gave him more delight than his connections with the various World's Fairs. He served on juries of those held in London, Paris, Vienna, and Philadelphia. During the terrible heat in 1876, while actively engaged in his duties at the Centennial Fair in Philadelphia, he was prostrated by sunstroke. He was promptly brought to his city home, but a cruel illness of many

months followed, and at last, when he was able to again consider the resumption of his work, strength was lacking. In consideration of his years of faithful service, the college trustees retired him with a pension, and he returned to the scenes of his student days. For a time he was in Hanover, then in Switzerland, also in France, and in Munich. The World's Fair in Paris during 1889 attracted him there; but finally, after an absence of nearly ten years, he turned his steps homeward, and spent the winter of 1890–'91 at his own country home in Stockbridge, Mass. When the spring came he was already making plans to visit the great World's Fair, to be held in Chicago, but suddenly and with scarcely any warning a trifling indisposition seized him, and he died on May 29, 1891.

As has been shown, Prof. Joy filled many places of high honor with distinction. His associates and pupils held him in worthy esteem, and from the scientific world at large he deserves a more than passing notice, for it may be said it was his efforts that indirectly brought about that recognition of science in this city that culminated in the organization of the greatest School of Mines in the United States.

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The ice scenery of the mountains of New Zealand was first brought to notice by the Rev. W. S. Green in 1882, who that year explored the glacier region of Aorangi, or Mount Cook. Since then visitors have been attracted to the mountain region in increasing numbers; a hotel has been built in a convenient situation near the foot of one of the glaciers; surveys have been undertaken; and a series of exploratory expeditions has been begun by Mr. G. E. Mannering and his coadjutors. The southern Alps proper of New Zealand run from northeast to southwest for about a hundred miles, nearer to the western than to the eastern coast of the South Island. Hence the valleys fall more rapidly toward the west than toward the east; and on the latter side a wide tract of plain separates the sea from the foot of the hills. Being pierced more deeply by the lowlands, although the New Zealand peaks are considerably lower than those of the European Alps—the summit of Aorangi, the highest of them, being only 12,349 feet high—they tower as high and as steep above their actual bases. Aorangi, according to Mr. Mannering, rises "for nearly 10,000 feet from the Hooker Glacier, and Mount Seften 8,500 feet from the Mueller Glacier, while the western precipices of Mount Tasman (11,475 feet) are stupendous." The snow-line in these mountains lies much lower than in Switzerland, being only about 5,000 feet above the sea. Thus the glaciers are greater and descend lower than those of Switzerland. The Tasman glacier is eighteen or twenty miles long, and terminates at a height of 2,456 feet above the sea. On the western side the ice approaches occasionally to within 600 feet. Thus in the New Zealand Alps, says Mr. T. G. Bonney, reviewing Mr. Mannering's book in Nature, "the Alpine climber meets with the same difficulties and is surrounded by the same class of scenery as he finds in the Old World amid peaks and passes 3,000 feet higher." But, great as are these glaciers, Mr. Bonney adds, they are, like those of Europe, attenuated representatives of their predecessors, for New Zealand also has had its Ice age.

# CORRESPONDENCE.

## AN AUTHOR'S PROTEST.

*Editor Popular Science Monthly:*

MY attention has just been called to the notice you have given, in the May number of The Popular Science Monthly, of the second volume of the report upon which I am engaged (see pages 131 and 132 of the May number). I am gratified by the approval expressed of the "report proper," "five hundred pages of well-digested matter," etc., as that is in an especial sense my own work; but it seems to me the writer would have been more just if he had stated that the work was avowedly largely a work of reference, and also that every device had been availed of to facilitate such reference.

This book is made for the use of educators and teachers, and its purpose is to record what has already been done in this country in introducing "Manual Training in Public Schools," and *also* to furnish those considering the wisdom of making any changes in this direction, with the experience, opinions, and plans of educators who have seriously considered or undertaken the work. All the literature on these topics is ephemeral and not within reach of the ordinary teacher nor to be found in ordinary libraries. It largely consists of speeches, papers, addresses, and local reports. The movement is a live one, progressing by rapid strides, and the material grows rapidly. My purpose has been to get together and put in the hands of the teachers *all the material* and *the latest* material possible. Now, the work of planning, collating, preparing, arranging, *proof-reading*, and indexing this big book falls upon myself alone, with aid, part of the time, of a single copyist. As fast as the matter is proof-read it is stereotyped; so the only way in which I could add later matter was to turn the "Introduction" into an extra appendix. I know, as well as the wise reviewer, that if I could have had all the material in those appendices spread before me in clean printed pages as he finds it in this volume, I also could have made a smaller and a better-proportioned book; but my aim was to be of most use to the educators and teachers, and my reward has been, much as it may surprise our critical friend, to meet with the hearty approval of all classes of educators, including the Presidents of Yale, The Massachusetts Institute of Technology, Johns Hopkins, Tulane; the superintendents of education throughout the country, educational authorities like Newell and MacAlister, and countless teachers; while the National Education Association in convention at Saratoga last summer took occasion to pass a special resolution of approval.

Now to consider the special features criticised for a moment. The contemptuous treatment given to my first volume by The Popular Science Monthly, and especially by the New York Nation and the Evening Post, was such as to lead me to think that it might be well for me to put on record the approving judgment of such educational and literary authorities as the veteran educators Henry Barnard and George Bancroft, the poet Whittier for his appreciation of Philbrick, and John Sparkes, the head of the Kensington Art Schools. The press of the United States and also of Great Britain and France gave generous and intelligent approval of the first volume of this report; but in the Cosmos Club, of this city, of which I chance to be one of the founder members, The Popular Science Monthly, and the twin sheets over which Mr. Godkin presides, are largely read; and, of course, my standing, in the opinion of those who accept these as divine oracles, suffered! I proposed that this abuse—for the Nation-Post article was largely abuse—should be offset, so that in case any of the Cosmos followers of Godkin chanced to open my second volume, they might find that there *were other* views!

Your reviewer criticises the fact that the tributes were paid to Philbrick, Smith, and Perkins; but surely, if anywhere it was proper to have printed tributes to these three great teachers, it was in this report, the first volume of which was but a record of their great experiment, as this second volume is a history of what has been the immediate outcome of their endeavor. I should have felt condemned had I failed to pay such poor tribute to them as was in my power. Those three citizens did more for their country than hundreds of ordinary citizens are enabled to do.

One hundred pages of the "Introduction" it was plainly stated were made use of as an *extra* "appendix," since that part of the book is printed last; but your reviewer suppresses that fact, and implies that this "Introduction" is all a mere mass of useless verbiage.

It is the easiest of all things to sneer, as your reviewer has done; but is it very manly in a journal, professing to be respectable and scientific, to treat a serious work in such a flippant vein? If other books are reviewed with as little of the spirit of fairness, or with the effect of so plainly seeking to belittle them, as is shown by the treatment accorded to this volume, I shall hardly look to the Monthly as giving any very valuable information about the works it assumes to notice. I have thought it due to the work to write this much of protest against the attitude assumed toward it by the writer in the Monthly; but

yet it seems hardly worth while, for the verdict of approval by those for whom the report was undertaken had been given long before this notice appeared; indeed, the demand by teachers and educators for this "overgrown volume" and for its predecessor is so much greater than the supply that the closing reference to "so many copies going back unread to the paper vat" falls rather flat to those who know the facts; of course, however, the falsehood, which is there implied as a truth applicable to this particular publication, helps to damn book and author in the opinion of the ingenuous and gullible reader. I. Edwards Clarke.

Department of the Interior, Bureau of Education, Washington, *April* 29, 1893.

[We have never received a protest which furnished us quite so much evidence in support of our own position as does this letter of Mr. I. Edwards Clarke. In his first paragraph he shows that we discriminated between the well-digested part of his second volume and the gatherings of his drag-net. In his second paragraph he states that his purpose has been to get together "*all the material*" on his subject, which involved the reprinting of much "ephemeral" literature, such as "speeches, papers, addresses, and local reports." He does not show that the purposes of a "work of reference," as he calls his report, necessitate the reprinting of these speeches, etc., *in full*, nor does he seem to see that the reason why such compositions *are* ephemeral is that they are not sufficiently condensed to be suitable for permanent preservation. We are gratified to learn that our reviewers of Mr. Clarke's two volumes arrived independently at the same opinion of his work, for we find that the person who noticed the second volume did not know what another writer had said of the first in the Monthly seven years ago. We are also gratified to find ourselves in accord with such an able critical authority as The Nation. It is not surprising that a great many teachers and educators have wanted the book enough to ask for it. We stated in our notices that it contains much valuable material, and complained only of the quantity of chaff among the wheat. Mr. Clarke has evidently done his work conscientiously, but he needs the wholesome, bracing atmosphere which surrounds the writers of books that must pay their own expenses, and which the Government bookmaker is protected from. Finally, if any more evidence of his tendency to diffuseness were needed, it would be afforded by the length of the letter above.—Editor.]

## THE TRACING OF THE PENNSYLVANIA GLACIAL MORAINE.

We have received the following letter from Mrs. H. Carvill Lewis, in reference to some remarks recently made in The Popular Science Monthly concerning the work of the late Prof. Lewis and Prof. G. F. Wright in tracing the glacial moraine across Pennsylvania. Having given our authority in the editorial (Correspondence Department) in the April number for the statements made in the article Recent Glacial Discoveries in England, in the December number, we publish the letter without further comment:

Hotel Lang, Heidelberg, *April* 16, 18 3.
*Editor Popular Science Monthly.*

Dear Sir: In reference to your editorial on Recent Glacial Researches in England, Popular Science Monthly, March, 1893, and to my statement that "it was only over the *last third* of the work (i. e., in the tracing of the terminal moraine across Pennsylvania from June to October, 1881) that Prof. Carvill Lewis had the pleasure and benefit of Prof. Wright's companionship," may I take the liberty of calling your attention to the inclosed letters, which will explain themselves?

The question as to whether Prof. Wright has on one or more occasions seen the whole or "three fourths" of the moraine in Pennsylvania does not seem to me the point at issue. It is simply this:

Is the statement in Mr. Warren Upham's sketch of Prof. H. Carvill Lewis's life and work, as quoted by yourself, that in "the following year (1881) Profs. Lewis and Wright *together* traversed the southern border of the drift *from Belvidere on the Delaware*," etc., "*to the line dividing Pennsylvania and Ohio*," correct?

To this question an exact knowledge of the facts of the case compels me to answer "No," and in support of this opinion I inclose you two letters, the latter of which was published by Prof. Wright himself.

The matter itself is of little consequence, but as the accuracy of my statement is for the general reader of the Monthly apparently controverted by the abstract you have given from Mr. Upham's article, I feel it best to produce proof of its correctness.

With regard to the map of the glaciation of England, which prefaced your article in the December number of The Popular Science Monthly, I regret to say that it does *not* "represent Prof. Lewis's work as completed in England by Prof. Kendall." I most heartily wish that it did!

The map in question has in its main features been copied from some of the leading English authorities—*possibly* from one of the maps in Geikie's Great Ice Age, to which it bears a strong resemblance.

*Over this older map*, which is quite at variance with my husband's leading conclusions, the tracks followed by Scotch and Lake District erratics, as traced by Prof. Kendall, and the moraine line across England and Wales only, as traced by my husband, have been drawn. The moraine line is tolerably accurate.

The points of agreement between Prof. Kendall and my husband, and the proofs more recently found by Prof. Kendall in northwest England (a part of the country with which he is thoroughly familiar) of the correctness of my husband's views with regard to the origin of the interbedded marine and glacial deposits of Lancashire and Cheshire, will appear in full in the first appendix of the memoir on my husband's observations in Great Britain, which is now in the hands of the printer. I am, with respect,

Faithfully yours, JULIA F. LEWIS.

The following letter, inclosed in Mrs. Lewis's letter, was copied by her from the work on The Terminal Moraine in Pennsylvania, by H. Carvill Lewis, introduction, p. li.

(*Letter of Transmittal.*)

PROF. J. P. LESLEY, *State Geologist.*

DEAR SIR: In transmitting to you the following notes on the terminal moraine, I desire to express my thanks to the Second Geological Survey, which has afforded me the opportunity to undertake an exploration which to me has been of the greatest interest.

I desire also to express my thanks to those citizens and railroad companies which have rendered assistance in the prosecution of my field work. Especially I am indebted to my friend Prof. George Frederick Wright, of Oberlin, Ohio, who for six weeks—about one third of the time employed in field work in 1881—gave me valuable assistance.* While we were together over a great part of the field, portions of the moraine in central Lycoming and southern Venango Counties were traced by him alone, and his experience in the glacial phenomena of New England has been of great value in correlating similar deposits in Pennsylvania.

Hoping the inclosed report will meet with your approval,

I remain, very respectfully yours,

(Signed) H. CARVILL LEWIS.

GERMANTOWN, *October* 15, 1882.

The other letter referred to by Mrs. Lewis is a letter from her published by Prof. Wright, to whom it was written, in Science of May 27, 1892.

# EDITOR'S TABLE.

## *THE ATTACK ON PROF. WRIGHT.*

WE publish in this number an article by Major J. W. Powell, Director of the Geological Survey of the United States, in which much interesting information is given as to the problems, or some of them, which the Survey has taken in hand to solve, and as to the methods of investigation which have been employed. Major Powell's primary object is, however, to clear the Survey of the charge of having made a concerted and most bitter attack upon Prof. G. F. Wright's recently published book on Man and the Glacial Period, and in this respect we are compelled to say that we think his article a failure. We accept without the slightest reservation his disclaimer of any personal responsibility in the matter; but with the evidence before us we find it impossible to believe that a number of individuals, directly or indirectly connected with the Survey, did not, in a concerted manner, set themselves to attack Prof. Wright's book, and that in a spirit of personal hostility and spite far more than of zeal for scientific accuracy. Considering the nature of the language indulged in by Mr. W J McGee in regard not only to Prof. Wright's book, but to Prof. Wright himself, we think the director of the Survey might have spared a few words in which to express his personal disapprobation of it; but we look in vain in his article for anything ot the kind. He admits that upon the publication of the work in question "his (Prof. Wright's) fellow-workers (on the survey) criticised the book in various scientific periodicals and sometimes spoke very disparagingly of it, as being unworthy of acceptance;" but he does not say that so prominent a member of the Survey as Mr. McGee penned and published an article

* I. e., in tracing the terminal moraine across Pennsylvania.—J. F. LEWIS.

breathing from the first page to the last the spirit of personal insult, and so far tried to set the key for the criticisms of other "fellow-workers." If the director had gone on and made this statement, which would have been quite relevant to the subject and purpose of his article, we think he would have felt it incumbent on him to express some opinion as to the expediency and propriety of his coadjutor's method of vindicating scientific orthodoxy as established at Washington. There is a manifest lesson to be learned from the incident. The Geological Survey is a body with wide ramifications, and whether it has already done so or not, it is in danger, from the very nature of its organization, of becoming a kind of scientific hierarchy, and, as such, of exercising an influence unfavorable rather than favorable to the increase of scientific knowledge. We learn from the director that when Prof. Wright proposed to publish his first book, The Ice Age in North America, Prof. Chamberlin, under whose direction he had worked as an assistant in the Survey, "demurred." It is really hard to see why Prof. Chamberlin should have taken upon himself to demur. Prof. Wright was not seeking to compromise any one but himself, and it was known that his work, of whatever character it might prove to be, would be fully open to criticism. If some scientific gentlemen could get it into their heads that science is not a personal matter, but a simple question of the establishment of general truths, and that every man is free to labor toward that end by the aid of such lights as he possesses, subject to correction by those whose lights are stronger and clearer, things would go more smoothly than they do in the scientific world, and the laity would not so often have to exclaim (with sarcasm), "See how these men of science love one another!" The services of Prof. Wright were dispensed with from the Survey—so the director tells us—because he failed to distinguish "overplacement" from original glacial deposit. We are not in a position to judge of the adequacy of the reason; but admitting that it was a sound one, might we suggest to the director that the writing of so discreditable an article as that which proceeded from the pen of Mr. W J McGee might perhaps be at least as serious a reason for removal from the Survey as even the non-recognition now and then of "overplacement"? As our readers are aware, the general soundness of Prof. Wright's observations was defended in a carefully written article by Prof. E. W. Claypole, which appeared in the April number of this magazine. It is not our part to enter into the controversy, but we can not help remarking upon the magisterial manner in which the Director of the Survey dismisses Prof. Claypole's article as being "based upon error in every paragraph." Let us hope that, if such is the case, some one will come forward and prove it otherwise than with a lofty wave of the hand.

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### *A BACKWARD MOVEMENT.*

We have often had occasion to notice the valiant struggles of our contemporary, The Nation, in the cause of rational journalism, and we earnestly trust it may not grow weary in well-doing, however potent the opposing forces may appear to be. We particularly wish it success —some measure of success, for there is no use in wishing too much—in its crusade against the fashion lately introduced by many of the daily papers of disfiguring their columns with woodcuts, far less for purposes of illustration in the true sense than as mere distractions for idle readers (save the mark!), who can not bear the stress of a score of lines of unbroken print. These cuts, the Nation says, with a measure of truth, are a natural sequence of the very childish editorial and news matter which many papers have for years past been serving up to the public. As our con-

temporary puts it, "The printed matter of some of them has for a good while been doing all that printed matter can to reduce the popular intelligence to that early stage which makes the life of nursery governesses and mistresses of kindergartens so hard, in which all the resources of pedagogy have to be exhausted to keep the child's attention fixed on anything." In a later article the Nation remarks that, for the purpose for which they are now employed, the "cuts" do not in the least need to be accurate. Their whole and sole purpose is to give a grown-up child something to look at, and whether or not they represent correctly the things or persons they are supposed to represent has simply "nothing to do with the case." The mind exhausted by the perusal of a dozen lines of letterpress finds refreshment and repose in gazing at a picture of any object, however common, connected in any way, however insignificant, with any incident, however trivial, that may form part of the gossip of the day. As the Nation sarcastically observes: "The great question of cabmen's beards might have been discussed indefinitely without the thorough elucidation given by a picture of a cabman with a beard, a cabman without a beard, and two or three cabmen prominent in the agitation."

Our contemporary fears that the end is not yet, that there is perhaps some lower depth of mental degradation to be sounded. A silly letter press prepared the way for yet sillier pictures, and the question now is what these are likely to bring forth as an ulterior result. If it is any comfort, we may reflect that the complaint of a growing childishness of the public mind is a somewhat ancient one. Without going further back, we recall Cowper's lines published in 1782:

"Habits of close attention, thinking heads,
Become more rare as dissipation spreads;
Till authors hear at length one general cry,
'Tickle and entertain us, or we die!'"

Nearly fifty years ago we find the poet Wordsworth inveighing against "illustrated books and newspapers" in a sonnet which, judging by later developments, does not appear to have had much effect, but which seems to express our contemporary's views exactly:

"Discourse was deemed Man's noblest attribute,
And written words the glory of his hand;
Then followed Printing, with enlarged command
For thought—dominion vast and absolute
For spreading truth, and making love expand.
Now prose and verse, sunk into disrepute,
Must lacquey a dumb Art that best can suit
The taste of this once intellectual land.
A backward movement surely we have here,
For manhood—back to childhood; for the age—
Back towards caverned life's first rude career.
*Avaunt this vile abuse of pictured page!*
Must eyes be all in all, the tongue and ear
Nothing? Heaven keep us from a lower stage!"

If the poet found so much to object to in the scanty attempts at so-called illustration made at the date at which this sonnet was penned (1846), what would he say to the present day development of the illustration business? He could have seen, had he lived to the present time, a picture, in a leading English paper, of the hide taken off the cow that ran down Mr. Gladstone; the cow itself was unfortunately killed and cut up before her likeness had been taken, but why that should have prevented the image of some other cow, of any cow, being offered to an intelligent public in her stead, or why the joints into which she was dissected should not have been severally photographed, and so exhibited as well as the hide, we have never quite understood.

It was a dictum of Auguste Comte, delivered about the time that Wordsworth was uttering his unavailing and, we must say, too undiscriminating protest against "illustrated books and newspapers," that the specific weakness of

the present age was a tendency to idiocy, which he defined as a condition in which mere sensations dominate and suppress mental activity: or, in other words, a life of excessive objectivity and defective subjectivity—insanity, according to him, being the exactly opposite condition. If The Nation is right in its diagnosis of present day tendencies, Comte was not very far wrong: and as that journal is certainly right in part, the question arises, What are we going to do about it? The first thing to do is clearly to recognize the nature and proportions of the evil. Illustrations in books and papers are useful when they either serve an æsthetic purpose or convey information of value which could not otherwise be as effectively conveyed. In scientific works they are, of course, indispensable. On the other hand, they do harm and not good when they minister to simple intellectual indolence, or help to gratify an aimless and idle curiosity. We are inclined to think that in children's books, even good illustrations (from an artistic point of view) may have the specific disadvantageous result of checking the exercise of imagination. The mind in childhood can make its own pictures, and will do so if nobody steps in with a picture ready made. With pictures illustrating every phase and turn of a story, there is little left for imagination to do and the faculty is apt to remain undeveloped for want of exercise. And an undeveloped imagination means an undeveloped, or at least ill-developed, individuality. There has been, we believe, a great deal of misunderstanding on this point in the past. It has been assumed that the more pictures children could be shown the more their minds would be stimulated; but, for the reason stated we believe this to be a great mistake. We can not further discuss the subject to-day, but it is manifestly one of much importance for old and young. Idiocy, or anything approaching to it, is not a condition of mind to be lightly cultivated.

### *THE "SAVAGERY" OF BELIEVING IN GHOSTS.*

It is a good rule that a scientific writer, before castigating the expressions of another, should acquire a right comprehension of what is meant by them. The Popular Science News seems to have forgotten this rule. Referring to our article in the March number on The Everlasting Ghost, that periodical says that, just like "any superstitious savage," we had assumed that the appearances described by the Rev. Mr. Haweis as having developed themselves on certain photographic plates were "ghost photographs." If our contemporary had read the papers in the case more carefully—Mr. Haweis's article, for instance, or even only the heading of it, or had even read our article with closer attention to its bearing—it would have observed that the precise thing we were ridiculing was the assumption that the appearances on the plate were "ghost photographs," and would then have been able to direct its shafts toward the right quarter. We do not underrate the value of research in this domain, or in any part of the field of unexplained phenomena styled psychical: but we do condemn the spirit that enters upon the investigation occupied with the idea that a certain thing—as, for example, the ghosts in this case—is to be found. The savagery in the present instance, if there be any, appears to be illustrated in the uncontrolled impulsiveness that prompted an attack where there was no offense.

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## LITERARY NOTICES.

Education from a National Standpoint. By Alfred Fouillée. International Education Series. Vol. XXIII. New York: D. Appleton & Co. Pp. 332. Price, $1.50.

Vive la république!—the welfare of the nation—is the keynote of this book. Educators who would have a complete and well-balanced understanding of their own field should not omit to study the relation of edu-

cation to national interests. Dr. Harris has chosen an excellent tutor for them in M. Fouillée, an eminent scholar and one of the race in which the national spirit is notably strong. Assuming that each nation has a continuity of character, mind, habits, and aptitudes which forms an organic heredity and identity persisting from age to age, the author inquires how education can be made to assist in perfecting this national nature. After a word on the importance of physical education he states that the chief objects of intellectual education should be—first, the moral; second, the beautiful; and last, the true. The reader should be cautioned against accepting fully M. Fouillée's representation of the effects of the study of science. In various places, and especially in the chapters on the Scientific Humanities, he denounces the present teaching of science as if it actually represented this field of knowledge at its best, and declares that science has been weighed and found wanting. He ignores the fact that science has been taught often by unsympathetic teachers, without suitable materials, and for a very short period at all. In his chapters on the Classical Humanities he is much more sympathetic, recommending these subjects as the very best means of fostering a national spirit. He criticises severely what is known in France as a modern education, and proposes a reformed system of secondary training which should embrace these studies: 1, the literature of the mother country; 2, Latin literature; 3, general history; 4, the elements of mathematics and physics. Where diversity arises, it should be in only the following special subjects: Greek, secondary science subjects with applied science, and modern languages. In conclusion, he maintains that all education will prove defective from the national standpoint unless it includes moral and social science, and unless its several parts are unified by philosophy. Programmes illustrating the author's views are given in an appendix.

A Contribution to our Knowledge of Seedlings. By the Right Hon. Sir John Lubbock, Bart. New York: D. Appleton & Co. In two volumes. Price, $10.

The results of a wide-reaching botanical research are embodied in these two substantial and copiously illustrated volumes. The subject of this research is the forms of cotyledons, which not only differ greatly in different plants but are generally much different from the forms of the ordinary leaves in the same plant. Some cotyledons are broad, others narrow; those of the mustard are kidney-shaped, of the cress three-lobed, of the beech fan-shaped, of the sycamore shaped almost like a knife-blade, of Eschscholtzia divided like a hay-fork, of the bean or acorn thick and fleshy. The shape of the seed seems to have an influence on the shape of the cotyledons. Where the cotyledons are narrow and lie straight in a long, narrow seed, the relation is simple, but such cases are few. Often narrow cotyledons are found coiled in orbicular seeds. In many broad seeds we find two fleshy cotyledons laid face to face, and occupying almost the whole of the seed. In the nearly spherical radish seed the cotyledons are laid face to face and then folded along the middle. In other species one cotyledon is larger than the other, or the halves of each cotyledon are unequal; still other cotyledons are lobed, emarginate, auricled, etc., and for all of these features the author has found probable causes in the shape of the seed or the way in which the cotyledons are packed within it. A general statement of these points occupies the early part of the first volume, while the rest of the work is devoted to descriptions of the seedlings in a large number of genera. In procuring the seedlings for these descriptions the author has been permitted to make large use of the resources of Kew Gardens. A valuable feature of the work is the carefully drawn illustrations of seedlings, sections of seeds, etc., of which there are six hundred and eighty-four. An index and a bibliography are appended.

The Theory of Wages and its Application. By Herbert M. Thompson. London and New York: Macmillan & Co. Pp. 140. Price, $1.

This is a piece of close and clearly expressed reasoning upon one of the great problems of political economy. The author says that his economic statements are, for the most part, those accepted by the economists of to-day. These statements he sets forth in the first chapter, and upon them he bases the proposition that "the universal product

of industry and abstinence" (the "universal dividend," as it might be called) "is a mass of wealth varying in amount, and divided in varying proportions among the agents to its production." Holding this view, the author obviously can not accept the wage-fund theory nor the theory that labor is the residual claimant to the product of industry, nor the doctrine that "rent does not enter into the expenses of production," and his next three chapters are devoted to criticisms of these doctrines. In his criticism of the first-named theory he comes in conflict with Mill, Fawcett, and Cairns; he takes Walker as a representative of the second, and Marshall and Sorley as supporting the last. In his fifth and final chapter he applies his theory of wages to the eight-hour movement, trades-unionism, profit-sharing, etc.

How Nature cures, comprising a New System of Hygiene; also, The Natural Food of Man. By Emmet Densmore, M. D. London: Swan, Sonnenschein & Co. New York: Stillman & Co. Pp. 405.

In this work Dr. Densmore makes a bold effort to shatter all existing and accepted systems of dietary, and ominously warns his readers of the dangers of seeking the assistance of the medical profession in cases of sickness. The book is divided into three parts: How to Doctor, How to Get Well and Keep Well, and The Natural Food of Man. In the first chapter of Part I the author gives an example of the process of natural healing, or, as he terms it, "Nature's engineering." He says: "A sliver becomes imbedded in the flesh—a frequent accident. . . . If the sliver is permitted to remain, Nature at once sets about a bit of engineering. First, there is pain and inflammation; then follows a formation of pus; this in due time breaks down the tissues immediately surrounding the sliver, especially toward the surface of the limb; the pus increases, breaks through, runs out, and sooner or later carries the sliver with it." And he claims that "these and like processes of Nature are all the healing force there is."

Further on, he asserts that the deaths of both George Washington and President Garfield were either hastened or directly caused by the drugs of the physicians in the first instance, and in the second by the daily probing for the bullet, which, if left undisturbed, would not have been fatal. All through the early part of the work the author advances argument after argument against the uses of drugs for healing purposes, and in the fifth chapter he makes the announcement that, although surgery can be classed as a science, "medicine is not a science; it is empiricism founded on a network of blunders."

The second part of the book treats of How to Get Well and Keep Well, and embraces a series of chapters upon the uses and abuses of certain foods and their relative values for promoting health. In the first chapter of this part, while admitting that "bread, cereals, pulses, and vegetables are the bases of the food of civilization," he denies the urgency of their forming the bases of food, and in fact distinctly states that these and all other starch foods are not beneficial to the system; and he urges the use of ripe sweet fruits in their place. This contention he bases upon the fact that starchy foods such as bread, cereals, etc., are not digested in the first stomach, but have to pass into the intestines, which they overtax during the process of digestion.

Considerable space is devoted to arguments against the use of tea, coffee, tobacco, and alcoholic beverages; and the author scathingly attacks the use, or rather the abuse of the use of opium by "orthodox physicians." In the third part are repeated his ideas upon the curative powers of Nature, and the evils of using starchy foods. In this part, also, he attacks the accepted theory that varying the diet is beneficial to the digestive organs, and advises a similar meal of meat and fruit every day. The book concludes with a number of "Conformatory Chapters," in which Dr. Densmore seeks to defend his theories.

Speeches of Sir Henry Maine. With a Memoir of his Life, by the Right Hon. Sir M. E. Grant Duff. New York: Henry Holt & Co. Pp. 451. Price, $3.50.

The man who is here portrayed in his public utterances and official writings was one of the leading lights of the century in the field of jurisprudence. In 1847, at the early age of twenty-five, he was made Regius Professor of Civil Law at Trinity College, Cambridge. Three years after he betook himself

to legal practice in London, which, together with lecturing and literary work, occupied his energies for twelve years. In 1861 he published his Ancient Law, which at once became an authority and a text-book. The following year he accepted the Law Membership in the Council of the Governor-General of India. He held this position until 1869, and during this period two hundred and nine acts were passed. The speeches and minutes that make up the body of the present volume relate to matters of East Indian legislation which demanded his attention during these years. Some of these matters concern the government of provinces—i. e., Judicial Taxation, The Bengal Legislature, and Over-Legislation; others, such as Divorce, Emigration, and Whipping, concern the daily life of the people. In all may be seen Maine's breadth of view and his temperate and convincing style of argument. Besides their biographical interest these documents have also a sociological value from the glimpses they give into the life and thought of the East Indian peoples. Sir Grant Duff's memoir tells much about Maine's university days, his writing for the Saturday Review and other journals, and recounts, also, the appointments and honors of his later life.

In Volume III of the *Journal of American Ethnology and Archæology*, *A. E. Bandelier* gives a most interesting outline of the documentary history of the Zuñi tribe, which will serve as an important link in the chain of evidences of prehistoric civilization on the northern portion of this continent.

At no time in our history has there been such an influx of speculative literature concerning prehistoric man in America as is now offered to ethnological students; considerable discussion existing as to the conditions of prehistoric man, his period of advent here, and probable characteristics and civilization. From among the many works upon this interesting subject it is still difficult to accept as satisfactory and conclusive evidence the consequential conclusions of the writers. Their researches are of decided speculative value to science; but they advance their theories and make their conclusions solely upon the vague probabilities of certain conditions and appearances of archæological discoveries.

The material used in this monograph is exclusively derived from Spanish documents, which the author was enabled to study in the archives of the Mexican Republic, and of the Indies, at Seville, Spain, and chiefly concerns the discoveries of certain Spanish monks between 1538 A. D. and the end of the seventeenth century. From these documents it is evident that a high degree of civilization existed among the Zuñi people early in the fifteenth century, and must have existed there for hundreds of years prior to the discovery of the country by the Spaniards. Here is an extract concerning the expedition of Fray Marcos, of Nissa, in 1538: "... About a month and a half ago there came a monk, lately arriving from some newly discovered land which, they say, is five hundred leagues from Mexico, . . . and toward the north. Of this country it is said that it is rich in gold and other valuable products, and has large villages. The houses are of stone and earth, the people use weights and measures, they are civilized, marry only once, dress in woolen goods, and ride on certain unknown animals." Another witness testifies that "there were many cities and towns well peopled; that the cities were walled and the gates guarded; that the people were very wealthy; that there were silversmiths; that the women wore jewels of gold, and the men girdles of gold and white woolen dresses; that they had sheep, cows, and quails, and that there were butchers and smithies." It is therefore evident that the Zuñi Indians possessed a civilization long prior to the advent of European explorers; and as the authenticity of these documents is unquestioned, we have, in the researches of Mr. Bandelier, some very important matter upon which to build further and reliable inquiry into the prehistoric conditions of man on this continent. Unfortunately, the almost total destruction of the archives in New Mexico by the Indians, in 1680, renders it difficult to secure a complete history of the past of New Mexico, and of the discoveries in Arizona which were made by explorers from New Spain in the early part of the sixteenth century. Nevertheless, in this monograph considerable light is thrown upon the conditions, civilization, and characteristics of the early dwellers of North America.

In a report on the *Relations of Soil to*

*Climate*, by *E. W. Hilgard*, Professor of Agricultural Chemistry in the University of California, which was published by authority of the Secretary of Agriculture, there are a great many suggestions concerning the effects of temperature and climate upon undeveloped soil and upon its physical character. It does not enter into the remedial possibilities of the question; but at the very opening of the paper Prof. Hilgard makes the interesting and valuable statement that "since soils are the residual product of the action of meteorological agencies upon rocks, it is obvious that there must exist a more or less intimate relation between the soils of a region and the climatic conditions that prevail." From this standpoint he discusses the effect of the phenomena.

At the Marine Biological Laboratory, Woods Holl, Mass., according to the *Fifth Annual Report*, some important biological discoveries have been made; among them, for the first time in history, the embryological "feat of tracing the annelid larvæ through every stage of development *cell by cell*." The report explains the purpose and work of the laboratory, and gives schedules of the different courses of instruction, investigation, etc. Several memoirs on amphibian development are in progress by the members of the laboratory, one of which is completed. It covers the whole period of development up to the establishment of the fundamental features of the embryo, including the formation of the egg and the phenomena of fecundation. Director Whitman closes his report with an appeal to American lovers of science to assist the managers of the laboratory by providing funds to enable them to extend their space and operations in giving instruction in marine biology.

In a paper entitled *Twenty Years of Progress in the Manufacture of Iron and Steel in the United States*, *James M. Swank* makes an interesting examination of these industries. He gives some statistical comparisons between the productions of Great Britain and the United States, which point to the fact that this country has not only passed her great rival in the production of pig iron, but also in that of steel. In the manufacture of Bessemer steel, ingots, and rails the United States has more than doubled the production of Great Britain, while the latter country still holds first place in the manufacture of open-hearth steel. His account of the change from iron to steel in the manufacture of rails is interesting, and shows that iron rails *practically* ceased to be manufactured in 1892. In a paragraph on the United States tin-plate industry he says, "The new tin-plate industry has made remarkable progress since the new duty went into effect;" and this he illustrates by some statistics of its growth. In the summary of his statistical statements Mr. Swank shows that the United States is now the first of all iron and steel manufacturing countries. The paper is an extract from the *Mineral Resources of the United States*, and is published by the Department of the Interior—United States Geological Survey.

*Horace V. Winchell*, State Geologist of Minnesota, makes a valuable report on the *Iron Ores of the Mesabi Range* of Lake Superior. He claims that the iron mines of this district are the richest "known in the world to-day," and he gives some interesting statistics of the output and probabilities of the Mesabi iron range since its discovery in 1890. The report embraces a history of the mining of the district, a list and approximation of the outputs of the mines now opened up, tables of analyses of the Lake Superior ores, and comparisons with those of other States and of Europe. The information concerning the methods of prospecting, sampling, testing, transportation, etc., in use at this range will be read with interest.

Mr. *William Bowker* contributes a very useful paper on the relation of fisheries to agriculture. It is entitled *The Harvest of the Sea*, and was read by him at the winter meeting of the Massachusetts Board of Agriculture. He makes a strong argument in favor of utilizing the non-edible and unwholesome fishes that abound in our waters—as well as fish refuse—for agricultural purposes. He gives some interesting extracts from the "*History of Plimoth Plantation*," showing that as early as 1621 the Indians were aware of the value of fish as a fertilizer, and he calls attention to the remarkable fact that the word *menhaden* was applied to the fish of that name by the Indians because it means "fertilizer, that which manures." Mr. *Bowker* pooh-poohs the idea that the supply of fish can be measurably

diminished, no matter what methods man may use for their capture; and he suggests the establishment of experiment stations for developing fish and other plant-food industries. (Boston: Wright & Potter, 1892.)

In pamphlets 202 and 203 of the United States Fish Commission *Bashford Dean* contributes some important data concerning the science of oyster culture. The first of these reports deals with the *Physical and Biological Characteristics of the Natural Oyster Grounds of South Carolina.* He draws attention to the appearance of immense natural but partly obsolete oyster beds on the coast of this State, and explains how oyster culture might be again profitably developed there. In the chapter on the Absence of Oyster Spat in Deep Water, Mr. Dean calls attention to the extraordinary silt suspension along the coast, and points out that this matter is, *de facto*, one of the causes why oysters do not thrive in the deeper waters. He claims that "to plant in deep waters clean shells as spat collectors would in this region be futile"; but that an abundance of both oyster seed and oyster food exist in South Carolinian waters, and that in the marginal waters, "from the level of low tide to about a fathom in depth," oyster culture could be very advantageously developed.

The second pamphlet is entitled *A Report on the Present Methods of Oyster Culture in France.* This subject is very interestingly discussed, and the result of Mr. Dean's observations will, by comparison, be of pertinent value to those who are interested in the conditions, industry, and culture of the oyster in American waters. He tells the entire process of oyster-raising in France, from the time the swimming fry becomes attached to the collectors until the grown oyster is shipped for consumption. He also defines the difference between the American oyster and the French "flat" oyster, which is akin to the English "native." The American and Portuguese are monosexual, whereas the "flats" are bisexual; so that, as says Mr. Dean, it is difficult to reconcile the relationship between both species. Both reports are profusely illustrated with photographs of the localities and processes of collection and general culture. (Washington, 1892.)

*Edwin T. Dumble*, State Geologist of Texas, in a report of 243 pages, gives an exhaustive treatise on the "character, formation, occurrence, and fuel uses" of the brown coal and lignite of his State. These coals are widely distributed throughout Texas, the coal measures of the "northern central portion of the State" occupying an area of several thousand square miles. Recapitulating the results of his investigations—some of which were made in Europe, for the purpose of comparison—Mr. Dumble claims that "brown coal and lignite, of good quality and under certain conditions, are fully capable of replacing bituminous coal for any and all household, industrial, and metallurgical purposes."

There are instructive chapters on artificial fuel, the composition of Texan coal, and its utilization and formation. And the State Geologist adds that as Texas has an abundant supply of brown coal "equal to the best which has been utilized, and far superior to much that has been used satisfactorily in other countries," there is no economic reason why the wonderful coal measures of Texas should not be more fully developed. (Austin: Ben Jones & Co., 1892.)

*Barton W. Everman*, Assistant Commissioner of Fish and Fisheries, has made interesting reports on the advisability of establishing fish-hatching stations in the Rocky Mountain region and Gulf States. In making such an investigation several considerations have to be taken into account. The chief requirement is a constant supply of *pure* water, "not less than a thousand gallons per minute," at a temperature not exceeding 50°; but of equal importance is the selection of a stream or spring free from contamination and containing as few as possible of such enemies of the *Salmonidæ* family and their spawn as the blob, etc. The first part of the report is devoted to his investigations in Montana and Wyoming. In some of the mountain streams no trout were found, and in many of those streams there was a marked absence of algæ, chara, and other suitable water vegetation. All the tributaries of the Columbia and Missouri Rivers were investigated—fifty-nine streams in all—and finally Dr. Everman considered that the most advantageous places to select as a hatchery are Horsethief Springs, Botteler Springs, and Davies Springs. All of these are close to Yellowstone National Park, in Montana, but he prefers Horsethief

Springs, which flows into the Madison River. He says that this stream "most nearly fills all the natural requirements." It abounds in suitable water vegetation, as well as in small mollusks and insect larvæ; it is already used as a natural hatchery and spawning ground by trout, whitefish, and grayling; the water never freezes, and, says the assistant commissioner, in making his recommendation, "they are among the most remarkable springs that are to be found in the United States." In the second part of the book Dr. Everman gives a report on his investigations made in Texas for a similar purpose. During this investigation thirty new species of fish were discovered, descriptions of which are given. Many excellent locations for a fresh-water station were found in the interior, but Dr. Everman says that "no point on the coast offers entirely satisfactory conditions for the establishment of a combined fresh and salt water station; but the Swan Lake site, near Galveston, might prove fairly suitable." The reports are illustrated with photographs of the localities investigated and of the fishes inhabiting each locality.

*Coals and Cokes in West Virginia* is the title of a pamphlet compiled by *William Seymour Edwards*, which gives, "in a handy form," a more precise knowledge of the coal measures and industry of West Virginia. It consists of a general review of the coal fields, and a series of chapters on their geological, stratigraphical, chemical, and physical condition. The greater portion of the work is devoted to tables of the chemical and physical analyses of the coals and cokes of the State "in comparison with those of other States in America and Europe."

*Third Annual Report of the Geological Survey of Texas. E. T. Dumble*, F. G. S. A., State Geologist. Austin: Henry Hutchings, 1892. Pp. 410, with maps and illustrations. This report embraces not only the geological and mineralogical conditions of Texas, but also gives some interesting historical facts connected with the development of the State. Accompanying the report are papers on geological investigations in Houston County, by W. Kennedy; Section from Terrell to Sabine Pass; Llano Estacado, or Staked Plains, by W. F. Cummins, notes on the geology of the country west of the plains; Stratigraphy of the Triassic Formation in Northwest Texas, by N. F. Drake; and several other reports dealing with the paleontology of the vertebrata and the cretaceous area, and Trans-Pecos, Texas. A considerable portion of the mineralogical part of the report is devoted to Prof. Dumble's investigations of the coal measures of the State; and in the chapter on Agriculture he explodes the idea that the Staked Plains was a wide expanse of desert sand. They were marked so on all "the old maps as the Great American Desert"; but the State Geologist says, "This has been proved to be utterly untrue, for there are no spots on this wide expanse upon which there was not formerly a luxuriant growth of natural grasses."

In Brochure I of Volume II of the *Proceedings of the Rochester Academy of Science*, Mr. *John Walton* contributes a paper on the Mollusca of Monroe County. He gives some useful advice to collectors of mollusca, and illustrates his paper with one hundred and thirty-five cuts of as many different varieties and species. Mr. Charles S. Prosser's paper on The Thickness of the Devonian and Silurian Rocks of Western New York, approximately along the Line of the Genesee River, minutely analyses the stratification of the Genesee section. The brochure also contains an article on the Guelph Formation in Rochester, and an interesting synopsis of the proceedings of the botanical section of the academy. (Edited by P. Max Foshay, secretary, Rochester, N. Y., 1892.)

The seventeenth year book of *New York State Reformatory at Elmira*, January, 1893, is a very exhaustive report of the condition, financial, educational, industrial, etc., of the institution. It was entirely produced by the inmates engaged on the institutional journal, The Summary, and is from the Reformatory press. It is beautifully printed on supercalendered paper and is profusely illustrated. The report of the general superintendent contains a plea for the establishment of "well organized and managed reformatory prisons," and he draws attention to the fact that most of the criminals are the product of "civilization" and "emigration to our shores from the degenerated populations of crowded European marts." In that portion of the book entitled Results there is a very interesting examination into the causes of criminality of certain prisoners, their prog-

ress during imprisonment, and their conditions, socially and industrially, after liberation.

In a volume of 194 pages Mr. *Nathan Cree* contributes a useful argument for *Direct Legislation by the People*, which is the title of his work. He does not claim that such a form of government would be a "remedy for all the political ills of society," but he points to many errors in the existing systems, and argues that at least an epoch of direct legislation would tend to better and more economic government. He says that "popular power in this country stands in no need of a vindication, either of its rightfulness or practicability," but he adds that the "power-holders do not govern directly, although elected by a widely extended suffrage." The author charges that the electoral bodies, which are the ultimate power in the United States, "delegate their powers to agents," and he seeks to prove that a modification of the present system combined with the primitive direct government would not alone be better and more interesting, but that the adoption of it is within the natural order of modern political evolution. (A. C. McClurg & Co., Chicago. Price, 75 cents.)

*Bulletin No. 7* (Part I) *of the Geological and Natural History Survey, Minnesota, N. H. Winchell*, State Geologist, consists of a descriptive and popular account of the features and habits of the *Mammals of Minnesota*, by *C. L. Herrick*. In consequence of the delay in the publication of the reports, which were handed over in 1885, this portion of the work contains only the descriptive and popular portion of the survey. The scientific part, which embraces the materials collected on the anatomy, especially the myology and osteology of the Minnesota mammals, will form the second part. Part I is clearly written, and will be welcomed by all lovers of natural history. It is illustrated with twenty-three figures and seven plates, and is published by Harrison & Smith, State Printers, Minneapolis.

In a volume of 128 pages, *Elizabeth E. Evans* offers to the public a peculiar theological discussion, which she describes as "a condensed statement of the results of scientific research and philosophical criticism, as applied to the history of religion." In her argument the authoress assails every Christian belief, and in the preface she declares that "all creeds are alike false." She scoffs at the idea of a Trinity as accepted by all Christians; says that Jesus was a myth or simply a pure man and a fanatic; and that "the idea of a God originated from the fears of man in the presence of the natural forces which he is unable to control." She seems to lean toward the doctrine of metempsychosis; and, while scoring the Roman Catholics and Protestants, pays tribute to the purity of intention of the Buddhist faith. (New York: Commonwealth Company.)

*J. E. Usher*, M. D., has given to the world an interesting and useful treatise on *Alcoholism and its Treatment*. Comparing the disease with insanity, he says that although the latter is a deplorable thing in any form, "no phase of mental breakdown is more far-reaching in its influence" than alcoholism. Tracing the disease through its "inherited" and "acquired" forms, he brings his reader to the fourth chapter, which is entitled Insanity and Alcoholism. Here, in four pages, he lays bare, with admirable skill, the awful resultant danger to chronic drunkards from the condition of insanity into which their over-indulgence has plunged or may at any moment plunge them.

The chapters on Alcoholic Trance and Crime and Cerebral Automatism or Trance are the most interesting parts of the work. They are devoted to the examinations of cases of murder, forgery, manslaughter, robbery, etc., committed while the automatic action of the brain continues from the action of alcohol. The last two chapters are devoted to the best means of treating those suffering from alcoholism, embracing a number of useful prescriptions as well as a ringing denunciation of all patent nostrums sold for this purpose. (New York: G. P. Putnam's Sons, 1892. Pp. 151. Price, $1.25.)

In a book of 184 pages, Mr. *Arthur Willink*, in order that a more easily comprehensive idea of God—whom he designates the Unseen—may be attained, says that his object is to submit as a proposition that "it is in higher space that we are to look for the understanding of the unseen." He carries us by a rather difficult but ingenious road through what he supposes to be the first, second, and third directions or dimensions of space to the "fourth dimension" or "high-

er space"; and here is where he locates the presence of God and also that of the departed souls. This invention he apologizes for by saying that it is "a terribly hard thing to realize." Nevertheless he assumes its existence and the conditions referred to for the purpose of penetrating, without irreverence, into the secrets of the unseen, for he says: "Seeking for the truth there is neither presumption nor irreverence, nor intrusion into forbidden ground, always provided that the search is prosecuted in a right spirit." Notwithstanding the ultra-scientific style of Mr. Willink in this work, and although it will not be understood by many, there can be no doubt but that his motive is excellent, and that the book will be read with pleasure by many of those interested in the higher theological subjects. (*The World of the Unseen.* New York: Macmillan & Co. Price, $1.25.)

In issuing a second edition of his work on the *Geographical Distribution of Disease in Great Britain*, Dr. *Alfred Haviland* has divided it, making Part I, now published, cover Cumberland, Westmoreland, and the Lake District (Macmillan, $4.50). In this part the geology and physical geography of the region are fully described, and the distribution of different diseases is set forth. There are several colored maps showing geological formations, contours, and the distribution of phthisis, cancer, and heart disease. In this edition the statistics of deaths from 1861 to 1870 are added to those from 1851 to 1860, used in the first edition. An appendix contains a list of plants growing in limestone districts, tables of population, etc.

In *The Dynamic Theory of Life and Mind* an attempt is made by *James B. Alexander*, of Minneapolis, "to show that all organic beings are both constructed and operated by the dynamic agencies of their respective environments." The author has gathered into his thousand octavo pages a great number of accepted facts in biology, paleontology, physiology, acoustics, optics, electricity, and psychology. Scattered through this mass of material is a limited amount of argument in support of his contention that "organisms, instead of being hand-made and purposive, are machine-built machines, and operated when built by forces outside of themselves." That is to say, that organs are shaped by the influence of functions upon parts not yet adapted to those functions, and that the activity of the organism is determined by stimuli from without. The data are drawn from competent sources, and all the author's statements are made in a clear and temperate style. Over four hundred figures illustrate the text.

The Geological Survey has issued a monograph on the *Geology of the Eureka District, Nevada*, by *Arnold Hague*, with an atlas. The area covered by the survey here recorded is about twenty miles square, and lies in the central part of Nevada. The monograph is a quarto volume of four hundred and nineteen pages, embracing a general description and a geological sketch of the district, with discussions of the rocks of the several epochs that are represented within the area in question, and an account of the ore-deposits found there. A Systematic List of Fossils, by C. D. Walcott, and a paper on the Microscopical Petrography of the Eruptive Rocks, by J. P. Iddings, are appended. Eight plates illustrate the text. The atlas contains eleven folio sheets, one covering the whole district, and the others representing the several divisions of it on a larger scale.

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# POPULAR MISCELLANY.

**Copper in the United States.**—Each of the main geographical subdivisions of the United States, according to Mr. James Douglas, possesses a distinct group of copper deposits. The Appalachian chain of mountains carries throughout its entire extent, from far beyond the northern limits of the United States to near the Gulf of Mexico, copper, which is chiefly but not exclusively contained in masses of iron pyrites imbedded in crystalline slates. Copper mines were worked before the Revolution in Connecticut, New Jersey, and Pennsylvania. More recently mines have been worked in nearly all the Eastern, Middle, and Southern States from Maine to Alabama, but most extensively in Vermont and Tennessee. From the great trough between the Appalachian and Rocky Mountain chains, drained by the Great Lakes and the Mississippi, but little copper has been extracted except from the State of Michigan. There have been small workings in other places, but not important. The copper-bearing beds of the Keweenaw series in Michigan, extending, but not in profitable veins, into Wisconsin and Minnesota, consist of beds of trap, sandstone, and conglomerate of doubtful age. Everywhere in Michigan the copper of this series exists exclusively in the metallic state. Three classes of deposits are worked in the Keweenaw promontory: the veins that yielded those extraordinary masses, stray blocks of which were reverenced by the Indians, which attracted the attention of the Jesuit fathers, and which have appealed to the popular fancy; copper beds of amygdaloid diabase, locally called *ash beds*, and amygdaloid traps; and beds of conglomerate, of which the cementing material consists in part of copper. There are sulphureted ores of copper in Michigan and Wisconsin outside of the Keweenaw series, but mines of notable productiveness have not been opened on any of them. The Rocky Mountain mines may be subdivided into two groups—those of southern Arizona and those of northern Montana. With insignificant exceptions, all Arizona copper comes from three groups of deposits: those near Clifton, at Bisbee, and near Globe. The ores heretofore yielded by these mines have been naturally oxidized, and with the elimination of the sulphur have been purified from certain other obnoxious elements which are commonly associated with sulphur. The Butte mines in Montana came into productive existence almost simultaneously with the mines of Arizona; but, instead of maintaining an almost stationary production, their record has shown an extraordinary augmentation of yield from year to year. Outside of Butte, no district promises in the near future to be largely productive. Promising indications of copper wealth exist in the Seven Devils' district in Idaho, but they have not been exploited. Nevada, Utah, and Wyoming have all yielded more or less copper, and all contain ores which under more favorable circumstances than now exist will be utilized. Colorado stands in the list as a producing State of growing importance. New Mexico does not produce much. On the Pacific coast, California alone has been notable in production.

**Coal-tar Perfumes.**—The revolution which chemistry has brought about in the manufacture of colors is now becoming apparent in the perfumery industry. As vegetable colors are being gradually replaced by the colors derived from coal tar, so artificial perfumes are gradually taking the place of the natural ones; and these derivatives from coal tar promise to give the best results in the future. Artificial perfumes are obtained by means of the ethers, liquids remarkable for their characteristic odors; by suitably composed mixtures by which imitations are obtained of the perfumes of fruits and of the principal alcoholic drinks; and

fixed formulas are given for each flavor and for each liquor. These artificial perfumes are much used for the preparation of confections into the composition of which neither fruit nor sugar enters, but only algæ, potato glucose, and artificial flavors, and of bonbons, jellies, liquors, etc. The essences of cognac and rum are also much used in the preparation of drinks with alcohols of grain, sugar beet, or potato. The perfumes of flowers are harder to imitate. Recourse was at first had to mixtures of other cheaper or more easily obtainable natural perfumes. An advance has now been made, and chemistry has succeeded in imitating these odors with substances derived from plants by complex reactions. The first perfume derived from combinations with the derivatives of coal tar was nitrobenzine, which was obtained by Mitscherlich in 1834, but is manufactured on a large scale only by Collas, in Paris, under the name of essence of mirbane. It has an odor like that of bitter almonds, and is used for perfuming soaps. Perfumes of similar origin have multiplied very much in recent years; and we now have among them artificial wintergreen, artificial musk, etc.

**Floral Festivals.**—In the arrangement in the Arsenal Garden, Tokio, Japan, of special collections of plants selected for the purpose of producing a display of flowers at different seasons of the year, Garden and Forest perceives an idea which can perhaps be adopted advantageously in other parts of the world. It is the expression, it says, of the love of the Japanese for particular flowers and of the popularity of the flower festivals held in spring, when the apricot trees and the cherry trees bloom; in summer, when the wistaria, the irises, and the morning-glories are in flower; and in the autumn, at the season of the chrysanthemum, and when the leaves of the maple trees assume their brilliant coloring. Every public garden in Japan contains collections of these plants, at least of the apricots, the cherries, and the maples, and they are visited by the greatest number of people when these plants are in flower. Their flowering is the excuse for parties of pleasure, and the intelligence of millions of people has in this way been quickened by their interest in the unfolding of petals of cherry trees or wistaria. Similar arrangements might be made in our own parks. "As our cities grow large and absorb the surrounding country, many of their inhabitants must pass their lives in ignorance of some of the most beautiful things in Nature, without beholding, for example, the glory of an apple tree in flower. In some corner of any one of our large parks, or better, in different parks of a series or system, a number of permanent outdoor flower shows might be arranged which would add immensely to their value as places of resort, and would have a powerful influence in directing and educating the public taste. There are many trees, for example, with showy and beautiful flowers, which display their greatest beauty only when massed together in considerable numbers; and if the people of our cities had the opportunity to see such collections, they would very soon make holidays for the purpose, and flower festivals before many years would become as much a part of our life in cities as they have in Japan."

**Superstitions concerning the "Black Devil."**—While the Dara Deil (*Forficula oleus*), or "black devil," a kind of earwig, used to be an object of almost universal abhorrence in the folk lore of Ireland. Its services were sometimes invoked in labor that demanded extraordinary physical exertion. In creeping along, whenever it hears any noise it halts, cocks up its tail, and jerks out its sting, which is similar to that of a bee. No reptile has been so much feared and dreaded by the peasantry as this insect, and it used to be commonly believed that it betrayed to his Jewish enemies the way the Saviour went when leaving the city of Jerusalem. It was no small gain to destroy this insect, for seven sins, it was said, were taken off the soul of the slayer. The people believed that the sting of the Dara Deil was very poisonous, if not mortal, and that it possessed a demoniac spirit. Under this impression, whenever it was seen in a house by the peasantry they always destroyed it by placing a coal of fire over it, and when it was burned the ashes were carefully swept out. It was not trodden on by foot, as a less formidable insect would be, nor was it killed by a stick, for it was believed that the poisonous or demoniac essence would be conveyed to the body of the slayer through leather or

wood. It has often been related that laborers have been enabled to perform extraordinary feats through the agency of the black devil, which they inserted in some part of their implements of labor; but the few who were so daring as to have recourse to such means were regarded as dabblers in the black art, and were looked upon as reckless, as "utterly left to themselves," and almost beyond the pale of salvation. This insect is still considered extremely dangerous; it is thought to be a kind of scorpion; but very few, indeed, are now disposed to lift it to the dignity of preternatural influence.

**Growth of Willow Trees.**—Garden and Forest has received a photograph of a willow tree standing in Waterbury Centre, Vt., the trunk of which measures twenty-four and a half feet in circumference, and whose symmetrical top shades an eighth of an acre of ground. A person who knows the early history of the willow testifies that in 1840 it was a tree about six inches in diameter, which had grown from a walking-stick driven into the ground a few years before by some children. In that year it was cut down deep into the ground in the hope of killing it, but it started a new growth, and has reached its present dimensions in fifty years. The rapid growth of the willow in favorable localities is well known, and Dr. Hoskins (from whom the photograph was received) writes of another near his home, which sprang from a cane carried by a returning soldier in 1866, and thrust into the soil in his dooryard. It is now more than four feet in diameter, with an immense top, and bids fair, at an equal age, to reach the dimensions of the one spoken of.

**The Jagir Duseens of North Borneo.**—The Governor of British North Borneo, visiting the island of Banguey, found there a tribe of Duseens, differing in language, religion, and customs from other tribes bearing that name. Among one of these people, called Jagir, spirits are believed in, and also the power of a priestess to keep them in order; "for she is acquainted with their ways, and knows the future as well as the past." She nominates and trains her successors, but they must wear black robes and carry wooden knives. The priestess thanks the chief spirit, on behalf of the tribe, at the harvest festival when the paddy crop has been successful; but the people never appeal to the spirits or practice any religious ceremony in connection with births, deaths, sickness, or marriages. Marriages are performed, without public gathering or feast, in the forest in the presence of the two families. The rite consists in transferring a drop of blood from a small incision made with a wooden knife in the calf of the man's leg to a similar cut in the woman's leg. After marriage the man takes the bride to her home, where he resides in future as a member of the family. These people have long hair, secured with a wooden pin at the back of the head, and cut short on the forehead. Their only covering consists of a scanty fragment of bark. They use for fire-making both flints and a pointed friction-stick, which differs slightly from the one generally used in the archipelago. The tribesmen are honest, trustworthy, and industrious.

**A Chinese Naval College.**—The Imperial Naval College at Nankin, China, according to Dr. Fryer's report, was opened about two years ago for the purpose of educating young men of talent for official positions in the southern fleet of the Chinese navy, the northern fleet having been already provided for. It has now eighty students between seventeen and twenty-five years of age, about equally divided between the branches of navigation and engineering. Two English teachers are engaged, with several Chinese teachers who have been graduated from the Tientsin Naval College and are employed as instructors in drilling, rifle practice, torpedo work, and other branches. The second classes of both the navigation and the engineering branches are also taught by qualified natives. The Chinese studies are directed by literary graduates, who teach the classics and other subjects of the usual course. With the good beginning it has had, and ample room for expansion, there can be little doubt, says the report, that the college, under its present administration, will eventually grow into a permanent institution that will bear comparison with some of those of foreign countries. The Chinese mind seems to be able to undergo a severe amount of study and discipline that is simply astonishing. Handicapped by having to keep up

their own classics and literary style, while all they learn of foreign subjects is through the medium of a new and difficult language, these youths must be made of the finest material to make any progress at all. The learning capacity and memory of a good Chinese student are almost beyond credibility. It is only in the invention or originating of new ideas or in making deductions that they are weak. Those subjects which depend chiefly on the use of mathematics have received the most particular care and attention.

**Sound Economics.**—Judging from the summary in the London Spectator, some sound economics are embodied in the utterances in a recent speech by Mr. Balfour touching upon questions of labor and social relations. The speaker animadverted on the unhappy consequences that might ensue from admitting that every one who wants work has a right to get it from the municipality or the state if he can not find a private employer. The admission of such a principle means municipal or state bankruptcy as the not distant consequence of works begun only in order to find employment for the unemployed without any guarantee that they will pay those who set them on foot. When private employment becomes hard to obtain, it is generally because the conditions of the time are unfavorable for effective labor. Now, if just at this crisis the public employer comes in, does it not mean that either the municipality or the state will pay as much for ineffective and ill-supervised labor as private employers have been paying for effective and well-supervised labor? That is only saying, in other words, that they will be paying high for bad labor. Mr. Balfour also gave a warning against attempting so to improve the distribution of wealth as to prevent its production where it is now successfully accumulated. The worst of the new combinations against the present rate of wages is that the rate of profits, already low, must fall lower if higher wages are to be paid, and the consequence of that must be the retirement of a good deal of capital from productive enterprises altogether. The rich manufacturers say to themselves: "We are as rich now as we really care to be. We would go on if we could secure our former profits; but as we can not, we may as well wind up business and retire." The consequence, of course, is that a great deal of wealth which was lately employed in reproductive operations is no longer so employed, and the raising of the general rate of wages becomes more and more impossible.

**Solid Air.**—At the meeting of the Royal Society, March 9th, Prof. Dewar communicated the results of his experiments upon air at very low temperatures. Having liquefied air at ordinary atmospheric pressure, the author has since succeeded in freezing it into a clear, transparent solid. The precise nature of this solid is at present doubtful, and it can be settled only by further research. It may be a jelly of solid nitrogen containing liquid oxygen, much as calves'-foot jelly contains water diffused in solid gelatin. Or it may be a true ice of liquid air in which both oxygen and nitrogen exist in the solid form. The doubt arises from the fact that Prof. Dewar has not yet been able by his utmost efforts to solidify pure oxygen, which, unlike other gases, resists the cold produced by its own evaporation under the air-pump. Nitrogen, on the other hand, can be frozen with comparative ease. It has already been proved that in the evaporation of liquid air nitrogen boils off first. Consequently the liquid is continually becoming richer in that constituent which has hitherto resisted solidification. It thus becomes a question whether the cold produced is sufficiently great to solidify oxygen, or whether its mixture with nitrogen raises its freezing point, or whether it is not really frozen at all, but merely entangled among the particles of solid nitrogen, like the rose-water in cold cream.

**Psychology of some Words.**—In his essay on The Language of the Mississaga Indians of Skūgog (a tribe remnant of less than fifty members living on Skugog Lake, opposite Port Perry, Ontario), Mr. A. F. Chamberlain touches upon some questions connected with what may be called the psychology of language. Only a few of the words appear to have an onomatopoetic origin. Neither the theory of Dr. Carl Abel of the designation by primitive man of the "A" and the "not A" by the same word—no trace of this combinatory process being perceived—nor that of

Wundt, that words referring to things or actions in the immediate surrounding of the speaker were shorter than those relating to more distant objects or actions, is confirmed. A few specimen words of various classes are given to illustrate the peculiar nature of some of the names: The word for the proper name of man signifies "chief bird"; that for woman, "sun in center of sky"; those for rainbow, "he covers the rain"; for milky way, "the sturgeon stirs up the lake of heaven with his nose and makes the water roily"; eclipse is "dead sun"; moon, "night sun"; spring (the season) is "good water"; Sunday, "worship day"; the toes are "they run in rotation"; corn is "grain of mysterious origin"; cranberry, "marsh fruit"; hammer, "the striker"; shot, "little duck ball"; horse, "it has one hoof"; cat, "little glutton"; blanket, "white skin"; and shirt, "thin skin." The method of procedure in forming words by combination varies from simple juxtaposition of words to complicated agglutination or word decapitation. The language has a large number of radical suffixes and affixes, or words that have no independent existence as words, but take the place of real words in composition. Some of the animal myths and beast fables of the tribe quoted by Mr. Chamberlain remind us of Uncle Remus.

**Origin of Fashions.**—The question of the origin of fashions has been much discussed of late, without any fully satisfactory answer having been found for it. Perhaps as nearly correct a theory as any is that of the London Spectator, which believes that there is no ruling mind in the matter, "no system of deliberate invention or choice at all. The leading dressmakers of London and Paris find their advantage in varying their designs as frequently as possible; and wherever a novelty achieves any success, whether it be in London or in Paris, it is immediate copied by other dressmakers, and its general adoption is as rapid as that of a slang word. Equally rapid is its course toward exaggeration; its salient features are further and further enlarged until the exaggeration becomes grotesque, the reaction sets in, and fashion swings back to the other extreme. Take, for example, those peculiar sleeves which are now worn. They began quite modestly in the shape of a little puff upon the shoulder; these excrescences grew and grew until they developed into the enormous and unsightly humps which almost eclipse the wearer's head when viewed from one side. The next stage will be the gradual retreat back from this monstrosity to the perfectly plain sleeve. The plain sleeve will begin to pall again; some one will invent a swelling at the elbow, and a swollen elbow will become fashionable, until exaggeration has caused it to swell beyond all bounds, and then back it will go to its primitive simplicity, until the whole operation begins again *da capo*. The whole working of fashion may be divided into three separate processes—genuine improvements with an idea either to beauty or comfort, which happen to hit the popular taste; exaggeration of these improvements; reaction from the exaggeration. That, at least, is how it appears to us. As to the originators of the improvements, we believe that they may be counted by hundreds."

**Excessive Schooling.**—The status and prospects of education were recently discussed by Lord Justice Bowen, of England, in an address at the London Workingmen's College. The speaker's view is described as one of "subdued hope." While education has within our day undergone changes that are hardly less than revolutionary, he admits that they have not been wholly for good. "The stream of knowledge has spread far and wide beyond its accustomed banks; it does not flow everywhere at its old depth. The first result of the flood is to fill the land with what seems to be a mighty river; the next is to hide to all but practiced eyes the course of the true stream. There is a wide expanse of waters, but they are almost everywhere shallow and very often muddy." Our modern education has been too largely vulgarized. The quality of the supply is inevitably affected by the quantity of the demand. The half-trained multitude can not distinguish between the best and the second best; and prolific mediocrity is at a premium. Yet we must not be too sadly disappointed that our overwrought expectations have not been wholly fulfilled. The more prudent advocates of popular education never pretended to present it as a cure-all. They never thought that it was designed to supersede morality and religion. They never expected

that it would at once remove all social distinctions or polish intellectual pewter into sterling silver. They have confined themselves to a modest trust that it may do something. It has done something already, and they humbly believe it will do more. Time is needed to measure the consequences of so great a social change. The new leaven has been spread among large classes of the nation hardly touched by it until yesterday. As one great benefit it has rendered the competitive system possible in the public service, and has saved the country from the evils of nepotism, and from the worse evils of a political scramble for the spoils. But competition is not a good thing in itself—only a "sad necessity." "The cultivation for market purposes of brute brain power" may, indeed, have its uses. It probably saves a large number of fairly able men from their innate inclination to sheer idleness, and it probably provides the public services with a regular supply of fairly competent recruits. But it can never, except by accident, breed a competent scholar. Its direct tendency is to divert the thoughts of those engaged in it from all that the real lover of learning and literature seeks with a constant love. But even the diffusion of "mediocre culture" gives the average masses a better chance of fulfilling their vocation than did the reign of general ignorance that prevailed among them not many years ago.

**Paradoxes of Animal Courage.**—Having mentioned a supposed hostility of wild dogs against tigers, a writer in the London Spectator goes on to remark that the fierceness of the wild dogs' attack seems to have affected the tiger—a clever and "reflecting" animal—with a kind of nervousness which extends to all dogs; and enforces his remark with the story of a tiger which ran away from the bark and spring of a domestic spaniel. "It is, of course, just possible that the tiger was 'nervous,' and that the little dog merely exhibited the impudence habitual to little dogs who know that they can worry a horse or a bullock into beating a retreat when quietly lying down in a field. Extreme nervousness is often the accompaniment of great courage in certain animals, especially of the larger kinds. Indian rhinoceroses, kept by a rajah for fighting in the arena, where they could exhibit the most obstinate courage in combats with elephant or buffalo, would tremble and lie down at the unusual sight of a horse outside their pen; and the elephant is more liable to sudden panics and alarms than any other animal. It is strange to think of the same animal advancing boldly to face a wounded tiger and receiving its charge upon its tusks, and running away in uncontrollable panic from a piece of newspaper blown across the road. It is said that the scent or roar of a bear in the jungle will often scare elephants beyond control; and they have the same intense nervousness shown by the horse at the sight of things unusual or out of place. A big elephant which was employed to drag away the carcass of a dead bullock, and had allowed the burden to be attached by ropes without observing what it was, happened to look round, and instantly bolted, its fright increasing every moment as the unknown object jumped and bumped at its heels. After running some miles, like a dog with a tin can tied to its tail, the elephant stopped and allowed itself to be turned round, and drew the bullock back again without protest. Yet an elephant, *with a good mahout*, gives, perhaps, the best instance of disciplined courage—courage, that is, which persists, in the face of knowledge and disinclination—to be seen in the animal world."

**A Whipping Game.**—The whipping game of the Arawacks of British Guiana, as described by Mr. E. F. Im Thurn, is played by any number of persons, but generally only by men and boys, for one, two, or three days and nights—as long, that is, as the supply of *paiwari*, the native beer, holds out. The players, with but brief intervals, range themselves in two lines opposite each other. Every now and then a pair of players, one from each line, separate from the rest. One of these puts forward his leg and stands firm; the other carefully measures the most effective distance with a powerful and special whip with which each player is provided, and then lashes with all his force the calf of the other. The crack is like a pistol shot, and the result is a gash across the skin of the patient's calf. Sometimes a second similar blow is given and borne. Next the position of the pair of players is reversed, and the flogged man flogs the other. Then the pair retire, drink good-tem-

peredly together, and rejoin the line, to let another pair take their turn of activity, but presently, and again and again at intervals, to repeat their own performance. It has been said that the most active players of this extraordinary game are the men and boys. But occasionally the women take a part also. And it is noteworthy that when this is the case a wooden figure of a bird, a heron, is substituted for each of the whips, and a gentle peck with this bird is substituted for the far more serious lash of the whip. "I do not know," says Mr. Im Thurn, "that any equivalent example of the fact that the germ of the idea of courtesy to the weaker sex exists among people even in this stage of civilization is on record."

**Cleansing Function of the Hair.**—Dr. Henry Sewell calls attention, in Science, to an example of the subservience of form to function afforded by the arrangement of the epidermic scales constituting the outermost layer of animal hairs. The buried edges of the scales point toward the root of the hair, while the free edges project obliquely toward the tip; and a hair glides between the thumb and finger far more easily when pulled from root to tip than when pulled in the opposite direction. When rolled between the fingers it will gradually move parallel to its length in the direction of the root. It follows that foreign particles may be easily moved outward toward the tip of the hair and away from the body, while it would be hard to push them in the opposite direction. Every movement of the hair, especially frictional disturbance, must set up a current of foreign particles toward the hair tip. The value of this property as a cleansing factor is evident.

**Telephotography.** — Telephotography is the name of an art the purpose of which is the production of photographs of objects at considerable distances from the operator, of such quality and scale that they can be examined and interpreted in a manner that would be impossible to the naked eye. The term is parallel in meaning with telescopy, and the art has as its aim the recording on a photographic plate of a combination of a number of distinct and separate telescopic impressions that can be obtained by sweeping a telescope over a greater field than that included in its own field of view, in the same manner, but to a less degree, that ordinary photographs record a number of distinct and separate visual images or impressions obtained by passing the eyes rapidly and almost unconsciously through the "wide" and "deep" fields of view, as they are termed. The apparatus consists of a combination of the telescope and photographic apparatus, with special supplementary lenses for magnifying the image and obtaining a flat field, the descriptions of which, by Thomas R. Dallmeyer, the inventor, are too technical for available use here. By it magnified and clearly depicted views are obtained of objects that are situated at such distances from the photographer that ordinary photographic means have hitherto rendered so small and insignificant as to be useless—views that are superior beyond comparison to enlargements of ordinary negatives.

## NOTES.

Japanese jugglers have exhibited a trick which consists in throwing knives at a person extended against a structure of boards, into which the knives appear to stick alarmingly close to the subject. The trick has been copied or imitated by European prestidigitateurs; but instead of real knife throwing and sticking, an illusion is arranged. Knives are hidden in recesses in the board structure, skillfully concealed by shutters, which open by a spring controlled by the target-subject. When a knife is thrown he moves one of these springs, and causes the hidden knife to emerge and appear as if stuck in the board, while the shutters instantly close; or the same is effected by means of wires controlled by persons behind the scene. The operator who throws the knife either casts it skillfully behind himself, among the scene-slides, or else throws it so that it shall strike, not into the boards, but on one side, where it falls noiselessly upon the carpet. The latter method is the best, because it enables the spectator to see the knife pass across the stage.

A full account of the Polynesian canoe is in preparation by Dr. N. B. Emerson, of Honolulu. The author points out in an article on the subject that the various migrations of the ancient Polynesians and their progenitors, from whatever sources derived, must have been accomplished in canoes or other craft, and that the *waa*, the *pahi*, etc., of to-day, however modified they may be under the operation of modern arts and appliances,

are the lineal descendants of the seagoing craft in which the early ancestors of the Polynesians made their voyages generations ago. He holds, therefore, that a comparative study of the canoes can not fail to shed light on the problems of Polynesian migrations and relationships.

The presidents of sections of the British Association for its meeting at Nottingham in September are: Section A, Prof. R. B. Clifton; Section B, Prof. Emerson Reynolds; Section C, Mr. J. H. Teal; Section D, Canon Tristram; Section E, Mr. Henry Seebohm; Section F, Prof. J. S. Nicholson; Section G, Mr. Jeremiah Head; Section H, Dr. Robert Munro.

The summer course in botany of the Torrey Botanical Club and the College of Pharmacy of the City of New York includes an annual course of ten lectures delivered between the last of April and July 1st, with ten conducted excursions—having the nature of extended out-of-door lectures—into the woods and fields. The course is provided as a means of instruction for business and professional men and women desiring to become practically acquainted with the chief principles of the science and with the local flora, but who have not the ordinary means of study provided by the schools and colleges.

A memorial volume is announced to be published by Wilhelm Engelmann, Leipsic, in honor of the seventieth birthday of Rudolf Leuckhart. It will include numerous contributions in the lines of their work by grateful pupils of Leuckhart, and will be illustrated by a portrait in heliogravure, forty plates, and forty-three figures in the text. In the list of contributors we observe the English names of Charles W. Stiles, C. L. Herrick, G. Herbert Fowler, Edward Laurens Mark, and C. O. Whitman, editor of the American Journal of Morphology.

A discovery made by Mrs. Zelia Nuttall and a reconstruction of the calendar system of the ancient Mexicans are described in the Report of the Peabody Museum of American Archæology and Ethnology as showing from astronomical data that the Mexican calendar has an antiquity of at least four thousand years.

An interesting testimonial was recently presented by Italian men of science to Prof. Maurice Schiff, of Geneva, on the occasion of his seventieth birthday. Prof. Schiff was from 1863 to 1876 Professor of Comparative Physiology in the Istituto dei Studi Superiori in Florence, where he introduced valuable improvements in teaching. He retired from that chair in consequence of the agitation excited against him by the anti-vivisectionists. He went to the school at Geneva, where he has acquired great fame and popularity. During his career he has enriched medical literature with many valuable contributions. The testimonial to him is an illuminated text on parchment, conveying the esteem and admiration in which his character and career are held, composed in Latin by Prof. Cavazza, and signed by an imposing number of surgeons, physicians, and medical teachers.

Investigations of the fermentation of tobacco by Suchsland have resulted in the discovery of different kinds of micro-organisms as active agents in the operation in the several varieties. Pure cultures of bacteria obtained from one kind of tobacco and inoculated upon another kind generated in the latter a taste and aroma resembling those of the tobacco from which they were taken. The discovery is greatly calculated to simplify the imitation of the finer varieties of tobacco.

An immunity against cholera is claimed for habitual users of vinegar, which is attributed by Mr. Hashimodo to the acetic acid contained in the best vinegar—a substance deadly to the comma bacillus. These bacilli were killed in fifteen minutes in an experiment in which they were treated with a vinegar containing only from three to four per cent of acetic acid.

The latest application of aluminum is to visiting cards, which are described as being thin, flexible, brilliant with a metallic luster, light, and admitting an impression of the names as distinct as it is made on paper. They can be made at a cost of about a dollar a hundred.

The results of experiments by Prof. Marshall Ward tend to prove that the action of sunlight is a far more powerful agent in the purification of the atmosphere than has hitherto been recognized. The author has discovered, for instance, that the anthrax bacillus, while it will withstand the greatest extremes of temperature, is killed by direct sunlight. Water is also thus purified.

## OBITUARY NOTES.

Ludwig Lindenschmit, a distinguished German archæologist, who died at Mainz, February 14th, in his eighty-fourth year, was director and one of the founders of the Central Romano German Museum of Mainz; one of the editors of the Archiv für Anthropologie; and author of works on German archæology. He began a general handbook on the subject, but completed only the volume relating to the Merovingian period. He was an advocate of the theory that the Aryan race is of European origin.

M. Alphonse Louis Pierre Pyramus de Candolle, the famous botanist, died in Geneva, Switzerland, April 9th. He was born in Paris in 1806, but spent most of his life in Geneva, where he became famous as an author and authority in his special branch.

PAOLO MONTEGAZZA.

THE

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## STUDIES OF ANIMAL SPEECH.

By Prof. E. P. EVANS.

THE enthusiasm with which Mr. Garner has devoted himself to the study of simian speech, and the general interest excited by his discoveries, naturally suggest a comparison of his investigations with those of his predecessors in this department of linguistic research. Perhaps the most serious and scientific attempt of this kind was made nearly a century ago by Gottfried Immanuel Wenzel, who published at Vienna, in 1808, a volume of 216 pages entitled Neue auf Vernunft und Erfahrung gegründete Entdeckungen über die Sprache der Thiere (New Discoveries concerning the Language of Animals, based on Reason and Experience), in which he maintained that the lower animals are capable of expressing their thoughts and emotions by means of articulate sounds, and that these utterances are not only intelligible to their kind, but may also be understood by man, indicated by alphabetical signs, and thus reduced to writing. He made a list of the sounds uttered by thirty different birds and beasts, and prepared a dictionary of more than twenty pages, to which he added a number of translations from animal into human speech. These so-called translations are very free, and give merely a paraphrastic statement of what he supposes to be the significance of certain canine and feline tones, the versions being confined to his interpretations of the colloquies of cats and dogs. As an illustration of his proficiency in this language and the practical value of such knowledge, he relates an incident, which sounds as though it might belong to the ancient and fabulous literature known to the Germans as *Jägerlatein*, or hunters' Latin. He once went to visit a friend, who was a great huntsman, but on learning that he

had gone out with his gun waited for him to return; meanwhile he took a book and sat down under a tree near a pen in which some foxes were confined. Suddenly he heard them utter certain sounds which according to his vocabulary were expressive of surprise and joy, and after listening for a time came to the conclusion that the foxes had discovered some means of escape and were exulting over the prospect of regaining their freedom. When the hunter returned, Wenzel informed him of what he had heard and advised him to look into the matter, but was only laughed at for his credulity and assured that the pen was perfectly secure. They went into the house, where they were taking some refreshments and talking about other affairs, when a servant rushed in greatly excited and announced that the foxes had escaped.

Wenzel admits that the language of animals is extremely simple and limited, and consequently monotonously repetitious; the same combination of sounds uttered with a stronger or weaker intonation serves to denote a variety of mental states and must be largely supplemented by lively pantomime. In conclusion, he has eighteen pages of what he calls an "animal pathognomic-mimetic alphabet," showing the value and function of each part of the physical organism, from the teeth to the tail, as a vehicle of expression. Dogs and cats fairly bristle with strong emotions, and birds show their ruffled feelings in their feathers and wax eloquent with their wings. Wenzel is convinced that every species of animal has its own dialect, which is to be regarded as a modification of the common or generic language of the race to which it belongs. Thus he seems to think that the zebra would understand the ass more readily than the horse, because the first two are more closely affiliated, although all three are endowed with equine speech. The same principle applies to the different varieties of the domestic hog in relation to other suilline quadrupeds.

As an example of the extent to which animals may acquire a knowledge of human speech he prints a communication from a clergyman who had taught his dog to fetch books from his library in an adjoining room. "Fido," he would say, "on the table near the window are a quarto, an octavo, and a duodecimo; go and get the quarto." Fido never failed to bring the volume designated. He had trained the dog to perform this service by showing him a book and saying very distinctly and repeatedly quarto, octavo, or duodecimo, and then laying it down in the library and making him fetch it. In the same manner the dog was taught to bring many other objects, the names of which he seldom confounded or misunderstood. The clever animal could also be sent on errands. "Fido," the clergyman would say, "go to Mr. B. and tell him that I shall call upon him to-day." Thereupon Fido ran to Mr. B.'s house and on finding him gave three short barks, which were per-

fectly intelligible to the person thus addressed. If any one called when the clergyman was out, Fido barked once; and he did the same if his master did not wish to be disturbed and bade him tell the caller that he was not at home. He announced a visitor by scratching on the door and barking twice. A Bavarian family at Munich has a dog that deems it highly improper for gentlemen to wear their hats in the house, but is sufficiently gallant not to find fault with ladies for doing so. An American, who wished to test the animal's discriminating sense of the fitness of things in this respect, entered the room and sat down with his hat on. The dog looked at him disapprovingly for a moment and then began to bark, with eyes intently fixed upon the hat. As the unmannerly visitor continued the conversation without paying any attention to these admonitions, the dog sprang up and, seizing the hat by the brim, pulled it off and quietly laid it on a chair.

Wenzel also tells the story of a dog whom his master used to send to the market for meat, and who would stand before the kind of meat he was instructed to get, beef, mutton, or veal, and bark once, twice, or thrice, according to the number of pounds desired. The butcher filled the order, and the dog trotted home with his purchase and the cheerful consciousness of having done his duty. Wenzel's little book is full of interesting anecdotes illustrating his subject, and has a frontispiece representing a landscape, resembling the traditional pictures of the garden of Eden found in old Bibles, with an ape, a dog, a horse, and a bull in the foreground, and the legend underneath: "They do not lie; their speech is truth."

The French physicist, R. Radeau, in a work on acoustics, published in 1869, treats incidentally of the language of animals, which he thinks one could, by careful observation, learn to understand and even to speak with fluency. Mersenne, in his Harmonie Universelle, asserts that men speak from a volitional impulse and utter vocal sounds in the exercise of a power of the mind which they are free not to exercise unless they choose to do so, whereas the lower animals use their voices under the influence of natural necessity, howling, shrieking, singing, etc., because under the circumstances they can not do otherwise, being subject to forces which they are absolutely unable to resist. The vexed question of the freedom or necessity of the will in human action, which metaphysics has vainly endeavored to solve, has been reopened by natural science and evolutionary biology and is now discussed on a broader basis and with the prospect of positive result. Whatever may be the final issue of these investigations, it is certain that the old Cartesian distinction between man and brute in this respect can no longer be maintained. Radeau is right in rejecting Mersenne's theory as involving a too subtile psychological

distinction and in declaring that his doctrine of natural necessity might be applied with equal force to many an inveterate gabbler who can not hold his tongue.

In this connection he relates the following anecdote on the authority of Jules Richard: In 1857 this gentleman had occasion to visit a sick friend in a hospital, where he made the acquaintance of an old official of the institution from the south of France, who was exceedingly fond of animals, his love of them being equaled only by his hatred of priests; he claimed also to be perfectly familiar with the languages of cats and dogs, and to speak the language of apes even better than the apes themselves. Jules Richard received this statement with an incredulous smile, whereupon the old man, whose pride was evidently touched by such skepticism, invited him to come the next morning to the zoölogical garden. "I met him at the appointed time and place," says Mr. Richard, "and we went together to the monkeys' cage, where he leaned on the outer railing and began to utter a succession of guttural sounds, which alphabetical signs are scarcely adequate to represent—'Kirruu, kirrikiu, kuruki, kirikiu'—repeated with slight variations and differences of accentuation. In a few minutes the whole company of monkeys, a dozen in number, assembled and sat in rows before him with their hands crossed in their laps or resting on their knees, laughing, gesticulating, and answering." The conversation continued for a full quarter of an hour, to the intense delight of the monkeys, who took a lively part in it. As their interlocutor was about to go away, they all became intensely excited, climbing up on the balustrade and uttering cries of lamentation; when he finally departed and disappeared more and more from their view, they ran up to the top of the cage and clinging to the frieze made motions as if they were bidding him good-by. It seemed, adds Mr. Richard, as though they wished to say, "We are sorry to part and hope to meet again, and if you can't come, do drop us a line!"

No one who has observed the actions and listened to the utterances of a clever parrot will accept Mersenne's assertion that the exercise of the vocal organs of animals is not free, but subject to natural and irresistible necessity, or that speech is in a greater degree the product of inevitable causation in the mouth of the cockatoo than in that of the cockney. Humboldt states that, after the Aturians on the Orinoco had become extinct, the only creature that could speak their language was a very aged parrot, condemned by adverse fortune to spend the remnant of its days in comparative solitude as the sad survivor of a once powerful tribe. From a philological point of view, the venerable bird was as interesting a character as the old Cornish woman with whose decease, some years ago, the dialect of her people ceased to be a

spoken tongue. It is also a historical fact that when, in 1509, the Spanish freebooters Nicuesa and Ojeda wished to surprise the village of Yurbaco, on the Isthmus of Darien, in order to capture a cargo of slaves, the vigilant parrots in the tops of the trees announced the approach of the enemy, and thus enabled the inhabitants to escape.

Perhaps the most cultivated and certainly the most celebrated parrot of which we have any record belonged from 1830 to 1840 to a canon of the cathedral of Salzburg, named Hanikl, who gave the bird regular instruction twice a day, from nine to ten in the morning and from ten to eleven in the evening. The parrot made rapid progress in the development of its mental faculties, and soon showed what a remarkable degree of intelligence it is possible for such a creature to attain under systematic tuition. The sayings and doings of this parrot which lived fourteen years after Hanikl's death and died in 1854, have been reported by a number of careful and competent observers and are unquestionably authentic. One day, as some one entered the room, it cried out in a harsh tone, "Where do *you* come from?" On seeing that the person was an ecclesiastical dignitary, it added, apologetically: "Oh, I beg pardon of your Grace; I thought it was a bird." It took part in general conversation, and was sometimes so loquacious that it had to be told to stop; it was also fond of talking to itself, and imagining all sorts of exciting scenes: "Beat me, will you? Beat me, will you? Oh, you rascal! Yes, yes, that's the way of the world." It whistled tunes and sang various popular songs, and even learned an entire *aria* from Flotow's opera of Martha.

A parrot of the same species (*Psittacus erithacus*), ash-gray, with scarlet-red tail, is now in the possession of M. Nicaise, a member of the Anthropological Society of Paris. This bird is nearly fifty years of age, and endowed with wonderful versatility of intellect. It imitates to perfection all the calls and cries of the street, and when in 1870 it was sent away from the beleaguered city into the country, it came back with its repertory immensely enlarged, having learned to reproduce the whistle of the quail, the hoot of the owl, the merry scream of the magpie, the crow of the cock, the cluck of the hen, and the tones of a great variety of wild birds and domestic fowls and quadrupeds. One of its histrionic masterpieces is the phonetic representation of the killing of a pig which it witnessed nearly a quarter of a century ago, but of which it has not forgotten a single characteristic grunt or squeal. Nothing is omitted, from the deep gutturals, alternating with piercing shrieks, as the porker is dragged to the place of slaughter, to the last faint groan of the dying animal. Indeed, the reproduction of the scene is so intolerably realistic, that the persons present are fain to stop their ears and to bid the bird keep si-

lence. It listens attentively to any conversation that is going on, and expresses its approval or astonishment by exclaiming "Oh!" or "Ah!" and always at the appropriate time or place. If any one tells a funny story or gets off a joke, it laughs with the rest of the company, although this outburst of merriment is doubtless due, not so much to a humorous appreciation of what is said, as to the contagion of the general hilarity. When it wants something, it calls its mistress by her Christian name, Marie, and, if she does not come at once, calls her again with a sharp tone of impatience. Once, when a firebrand fell on the hearth and filled the room with smoke, it cried, "Marie! Marie!" in a voice indicating extreme anxiety and alarm. This parrot is a provident creature, and when taking its dinner always lays aside a piece of bread and jam for its supper, thus showing that it has the power of looking before and after, which Shakespeare deems a peculiarly human attribute. It not only sings songs correctly, but also inprovises musical compositions, which it renders each time with new variations, and performs, as M. Nicaise assures us, "with a taste and style and spirit that might excite the envy of any pupil of the conservatory." The fact that these pieces invariably close on the tonic or keynote proves that all the modulations are referred to the fundamental tone of the chord, and gives evidence of a musical feeling and sense of harmony such as only human beings are usually supposed to possess. These improvisations are whistled, and sound as though they were played by a flute, the performance being uniformly preluded with runs and trills and other vocalizations.

The parrot is an exception to the rule that the period of infancy is longest in the most intelligent creatures. Its babyhood is, in fact, very short, although its average life seems to be somewhat longer than that of a man. It attains the full splendor of its plumage and is pubescent at the early age of two, and often survives all the members of the human family in which it has been reared, outliving even the children much younger than itself. During all this time it retains its mental plasticity and progressiveness, never ceases to learn, and goes on developing its inborn capacities from the beginning to the end of its prolonged existence. It is quite as inquisitive as the monkey, and quite as capable of close and continued observation. Merely through its association with man it is constantly making new acquisitions of knowledge, and there is no telling what might not be accomplished in this direction by systematic instruction carried on through successive generations.

If Mr. Garner's object had been to ascertain how far animals can acquire the use of human speech and what effect such discipline would have in enlarging their intellectual faculties, he

would have done better to choose parrots instead of monkeys for his experiments; but as his purpose is to learn the language of animals, and not to teach them his own, he has done well to select apes as the objects of his study. It must be confessed, however, that the results of his investigations, embodied in his volume recently published, are rather disappointing, and are, in fact, less comprehensive, although doubtless more accurate, than the observations made by Wenzel at the beginning of the present century. He is prone to lay great stress upon matters that are really of no importance whatever, as, for example, when he discovers that "No," accompanied by a shake of the heads is the sign of negation, and adds, "The fact that this sign is common to both man and simian I regard as more than a mere coincidence, and I believe that in this sign I have found the psycho-physical basis of expression." It is difficult to perceive how a logical thinker could draw such a sweeping conclusion from so slight premises. If he finds that gorillas and chimpanzees in their native wilds, unaffected by human associations, express dissent by shaking their heads and shouting "No!" it will be a fact well worth recording.

Mr. Garner's superiority to his predecesssors in this department of linguistic research consists in the greater excellence of his material rather than of his mental equipment. The possession of the phonograph alone gives him an immense advantage in this respect, by enabling him to record and to repeat the utterances of monkeys with perfect accuracy. Armed with this scientific weapon of phonetic precision and all the instruments and appliances which modern invention has placed at his disposal, he may perhaps completely conquer a province of investigation hitherto but partially explored, and, by making important contributions to zoöglottology and working out a system of alphabetical signs for the language of the anthropoid race, become the Cadmus of the simian world.

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A Bengali in India has made a contribution toward the expenses of a "snake laboratory" which it is proposed to establish in Calcutta. The work of the establishment will include the scientific examination of supposed cures for snake-bite, and the investigation of the properties of the snake poison. The laboratory will be the only institution of its kind in the world.

The expedition of Sir William Macgregor to Mount Owen Stanley in New Guinea found a remarkable native bridge spanning the Vanapa River. It is a woven bridge, suspended from trees on each bank, and is similar in every respect to the bridges built by the Malays of Sumatra and the Dyaks of Borneo. The view of it given in Mr. J. P. Thomson's British New Guinea shows it to be an elegant and picturesque structure.

# LEARN AND SEARCH.*

By Prof. RUDOLPH VIRCHOW.

OUR university has during its existence, now for more than eighty-two years, celebrated the beginning of a new university year in a peculiarly solemn manner. This October day is the one among the festivals it observes which invites it to enter into self-contemplation, to a review of its acquired results, to a testing of the ways it has struck out, and again to the consideration of new problems and to a look into the future. Have we solved the problems that are set before us? Have we made a faithful use of the means for training youth for the highest objects of the state and of manhood? Can we surely expect that the hopes which we and the Fatherland have built on our work will be realized? It is incumbent on the new rector to be the interpreter of these problems. But whose mouth is eloquent enough to give common expression to the often widely diversified thoughts of his associates? How few of us succeed in obtaining even only a general view of the ever newly changing phases of single special branches! None of us, we often confess, is a bearer of all knowledge. Each of us can do no more, with the best will, than judge from the point of view of his own branch, of his own single experience out of the whole course of studies at the university. Hence the temptation is pressing to make his own branch rather than the generality of the studies the subject of his review. I shall endeavor to avoid this rock.

The confidence of my associates has called me to this high position forty-six years after I entered this faculty as a *privat docent,* and after I have been active forty-three years as an *ordinarius* in a foreign university and here. Great changes have taken place, not only in public affairs, but also in knowledge—greater than in hundreds of years before. All the single fields of human activity have been transformed, many fundamentally, or at least subjected to the incisive attacks of criticism. How could one who has participated busily in public life have passed through so great experiences without realizing it and without disturbance? Yet university life is not isolated amid the general intellectual life of the people. We are obliged to look around from our instruction upon instruction in general, the elementary and preparatory instruction which youth eager to learn bring to us, as well as upon the instruction in the various higher or technical schools, one after another of which has developed the intelligible effort to be, or at least to be called, a high school. To

* Rector's address at the Friedrich Wilhelm's University, Berlin, October 15, 1892.

the lower institutions the university is a perpetual association to prepare their pupils so that they shall receive our instruction with full understanding; for the higher schools, it is a model after which they may shape their methods and regulations. On the other hand, the university is called upon to introduce to the state and society successive new generations of young, well-prepared men, who, filled with arranged knowledge, impelled by moral earnestness, preserve and bear the sacred flame of learning through all the perplexities and dark passages of daily life.

There was a time when this sublime position of the university was not only generally recognized, but was also distinguished by great prerogatives. Many of them have since been lost. We have, perhaps, only temporarily, but still happily, passed the days when the strongest attacks were made against the universities and the narrowest limitations were imposed on their freedom. But we will not forget that even this university, which was founded in the most difficult period, in order, according to the word of its founder, King Friedrich Wilhelm III, to be "the nursery of a better future," was subjected to a suspicious and close watch. Various motives worked together to bring about this unhappy condition. One of them, and one which you, dear fellow-laborers, may contemplate with advantage, lay in the behavior of many of the students, and consisted in a widespread misunderstanding of the purpose of the study and the position of the student.

No less a person than Johann Gottlieb Fichte first occupied the position from which I speak to-day. In the memorable address "On the One Possible Disadvantage of Academic Freedom" (*Ueber die einzig mögliche Störung der akademischen Freiheit*), which he delivered as the first chosen rector of our university on October 19, 1811, he spoke the significant words, worthy of being taken to heart: "He only is a student who just studies." With prophetic mind he described whither the course tends, when the student, instead of making it his chief purpose to learn, instead of "sinking, as he ought, his whole thought and mind in learning," spends his time in nursing antiquated traditions of a special privileged condition of students and in maintaining supposed prerogatives. It is sufficient to refer to this address, which every student may be advised to read. Fichte at that time expressly disclaimed speaking of conditions which existed at this university, but referred to the cases of other universities; and the earnestness of his admonitions reveals that he regarded the danger as menacing, and, in fact, as so menacing, that he saw in it the "one possible disadvantage of academical freedom."

The severe crisis which came on a few years later and involved all the German universities has at last passed away, and it has, as we recognize with thanks, left unscathed the two

chief features for which we have every reason to be proud in a comparison with other nations of Europe—freedom in teaching and freedom in learning. Teachers and pupils have still that independence and self-reliance which promote vigilant responsibility and exclude strange control. The freedom in teaching in particular, which was preserved till the dissolution of the German Empire through the special concessions of the emperor and the nobles, has in our time become a constitutional right. The free choice of the rector by the regular professors has also remained to us, and the corporate character of the university has not been attacked.

Several other privileges, indeed, which originated in the time when the student body was almost sovereign and the customs of the middle ages determined the form of the student's life, exist no more. The academical jurisdiction has been reduced to a few disciplinary rights; our scepters, which were conspicuous on days like this, are more ornaments than real insignia of power. The student is now in full sense subject to the civil law. He is a citizen like the others, and he knows that he has no other privilege than the right of freedom to learn preserved to him on the ground of what he represents, and the right won by proficiency in university studies of obtaining money and a part of the highest positions in the state. In other respects we have no academical freedom different from general civic freedom. The student has no special right. The academical citizen like the citizen of the state looks for the source of his right in the constitution of the state. But this constitution has given him more rights than he formerly had; especially the right, under limitations prescribed by the constitution and the law, to participate in political life without being subjected to any exceptional rule.

Therefore, dear fellow-students, take the sincere counsel to pursue learning as your first and most important object, with full knowledge of all its results and with devoted earnestness. Self-evident as this advice may seem to be, experience teaches that it can not be repeated too often and too impressively. This is true as well for the later semesters as for the first. The more difficult and comprehensive the branch the entering student selects, the earlier should the methodical study begin, for the instruction of the later semesters is comprehended only on the basis of the earlier instruction. The temptation to the young student first to enjoy academical freedom in not-learning is certainly very great. To one who passes from the constraint of the gymnasium into the golden freedom of the university it is a privilege to stretch his limbs and to conduct himself without regard to later things. We all know this, and are accustomed to exercise "academical indulgence" toward this way of using academical freedom. But there

must be limits to this indulgence, for it is not really academical freedom as we understand it and as the state should understand it. "Academical freedom" does not mean "freedom in not-doing" or "freedom in pleasure, or in the gratification of the passions," but "freedom to learn." This is real academic freedom, and the university has been opened to students for its exercise.

Neither teachers nor scholars should forget that the object of the university is a very high one, namely, general scientific and ethical cultivation and full knowledge of the special branch pursued. Once at least in his life, at the close of his university career, the cultivated young man should be so far advanced that his knowledge, especially in his own branch, should correspond with the average condition of scientific research. If he does not succeed in that, there is little hope that he will ever become an honored specialist in the circle of his associates. He has every prospect of continuing a bungler all his life. Let no one, therefore, be deceived: only in exceptional cases does a period of freedom to learn like that normally possessed by the academical citizen return in later life.

To the exercise of this freedom the desire to learn is essential before everything else. Whoever desires to learn at the university will have to decide at once what and how he will learn. The indifferent pupil shirks this decision. His choice does not really concern the kind of learning; it wavers principally between learning and not-learning. The university possesses no means of compulsion to enforce learning. The means of discipline and regulation at its command are not adequate to secure participation in instruction; only the medical faculty has in its examinations obligatory provisions which are adapted to secure a certain order in the succession of lectures and exercises. Yet experience teaches that complete success can not be reached without the desire to learn. How can this desire be aroused?

In so large a university as ours the personal influence of the teacher on individual students is naturally very limited; only special conditions can enable him to form close relations with a smaller circle of hearers, or exceptionally with single hearers. His influence is, therefore, chiefly exercised upon the mass of students, and he often first learns from a later examination how little of this influence the individual has received. We can declare with pleasure that the number of hearers who followed the instruction with ardor and success, even with distinguished success, is not small. But it would be a mistake to conceal the fact that the complaint of the teacher very often is that his trouble has been in vain. Many go further, and assert that a progressive diminution in the work accomplished by the students may be remarked.

This is especially the case in those branches the substance of which is all strange to the newly entered student, and is endowed with an oppressive copiousness of new ideas, as, for example, in jurisprudence and medicine. Precisely in these branches is the course of the student in the first semester often decisive for his whole development, and indeed for his whole after life. For in them one lecture is built methodically on another, and no one can properly understand the superstructure without having become acquainted with the substructure in all its parts. Else there arises a piece-work of fragmentary knowledge without proper foundation. All the teacher's later influence can not fill up the gaps.

Doubtless the difficulty of the matter contributes to make beginners waver in their zeal; and yet it is the beginners on the gaining of whom all depends. Does the responsibility for a pause in learning occurring so often in the first semester rest upon the university teaching? Such a reproach can not be raised, even on the strictest investigation, and it has not been raised to my knowledge, at least not in a corresponding generality. On the contrary, all the considerations lead to the question of preparatory training. This point is at this instant engaging most extensive consideration. The attention of all cultivated persons, and no less of the Government, is directed to the question of what changes in the instruction in the higher schools are demanded in order to reach that measure of preparatory training which can assure a wholesome progress in the studies of the universities. It would far pass the scope of my address to discuss this highly important question in all its parts. The debate goes on concerning the subjects of instruction, the amount of time which should be given to each, the method of teaching, and finally the amount of work to be laid upon the students, and also upon the teacher. The experience of the university teacher has been large enough to enable him to form a judgment upon the majority of these questions. It will be sufficient for the present discussion to touch upon only a few of the less frequently mentioned points.

The university teacher has before everything else two demands to make upon the higher schools, which are in close connection with each other. He should require that the *abiturients* bring with them the desire to learn and the capacity for independent work. The proof of positive knowledge of any particular sort should give way to these demands. Individual faculties will make various requisitions with reference to them; but it will be hard to show a serious difference concerning the main point.

The desire to learn is originally present in every normally endowed child. We daily witness the joy of the infant when he succeeds in comprehending a new thing or perceives some new

action of his organs. His pleasure increases with every advance that he makes. This property is innate. How it is exercised is in the first place dependent on the condition of his organs. Many diversities of behavior appear among children early, according as they are limited by inborn, and often inherited, differences in their faculties.

Is this property peculiar to children alone? Surely not. It abides in the man till his mature age, provided his organs are normal, and as long as no disturbance or interruption by outer influences intervenes. What pleasure does even the learned man experience when a new field of knowledge is unlocked to him; even in his old age, how enlivened is his thirst for learning when he succeeds in getting a glance into new series of phenomena of Nature or of the human mind which had been previously incomprehensible or inaccessible to him! How does it happen that young, cultivated men, under training to become academical freemen, escape this general human property? It is in them without doubt, but has not rarely been repressed by some objectless treatment. Then the thing to be done is not to call it out for the first time, but to revivify it.

From the desire to learn, when well directed, is developed the desire for knowledge. Not satisfied with the knowledge of a fact, with the perception of a phenomenon, the desire to learn urges on to the understanding of it. It searches for the connection of phenomena and processes, their history and causes, and is never quite satisfied till it has grasped their genetic and causal relations. This is the mark of a real desire for knowledge. With it comes the beginning of research. A disposition to investigate can be recognized in the child to the extent that it divides the object it has in hand into its parts and tries to put them together again into a whole; or it imitates a movement, to learn what it must do to bring it about. Training thus finds all the elements present; it has only to use them and direct them in methodical ways. This comes to pass when attention is fixed on the connections, interest is stimulated, the study is directed to the principal fact and diverted from the subsidiary ones.

We can now raise the question, Does this take place in our schools? Even in the lower schools the desire for learning is so greatly perverted that with no small portion of our people, not the love of knowledge, but only its lowest form, curiosity, is cultivated—that disposition which is satisfied with a superficial and therefore incomplete comprehension, following which attention is directed to new objects. Thus, an innate and naturally worthy property is misdirected and brought to a form of expression which is at least purposeless and not rarely injurious.

When the love of knowledge is awakened in the childish mind

and the child is also led to a consideration of genetic and causal relations, attention should be directed to historical events. With right that instruction which points at most to a more formal transmission of precepts—religious instruction—is not limited to mere dogmatic teaching, but seeks in sacred history a means of learning. But nothing is so highly adapted to such teaching as what is called natural history, in which real objects are dealt with, and genetic processes may be immediately demonstrated. Our Folk schools are making daily progress in observational instruction, and it is only to be desired that the application of mere pictures may be supported by illustrations from real objects.

In the higher schools teaching of the languages has had the lion's share from the beginning. As the gymnasia grew out of the Latin schools of the middle ages, the preference of Latin has remained their constant inheritance. The Greek, the introduction of which is due to the humanists, has taken a place by its side. This circumstance has had the happy result, we thankfully recognize, for enlightened Europe, of gaining for all those peoples who have had a part in it a common basis of cultivation which has contributed more than anything else to promote mutual understanding and the feeling of fellowship. During a long time the general use of the Latin language by the learned has in the most opportune manner facilitated the intercourse of all literary men.

The condition has now become different, very different; and even those who, fully recognizing the highly beneficial influence of the classical languages upon European civilization, desire a continuance of their study, must grant that it is impossible to restore the old relations. The national languages have come into their natural right, and much as we may deplore the increasing polyglot character of learned works, and evidently as it concerns us that we are not qualified to read a multitude of excellent treatises in the original, we must still recognize that no power in the world is competent to produce a change within a conceivable time. Our literary schools only exceptionally furnish graduates who can speak Latin or write a fluent Latin essay; and the universities have been forced, contrary to their inclination, to remove the Latin language from their courses of instruction and from practical use. The confusion of tongues has entered the learned world and secured its sanction.

It was from the beginning on the weak side of the humanistic institutions that they preferred Latin. It must be conceded that they could not do otherwise. They found the Latin the universal language of the Church and the land. They were Latin schools. They simply continued what had been the general praxis through a thousand years of exercise. But they received with it

an element of weakness. For the classical writers of Rome were far behind those of Greece in their achievements; indeed, the best among them owed their culture to Greek predecessors, and the schools of Athens always held the first rank in the esteem of men. Their teachings constitute the background of all literary achievement. Our Western civilization has received its most peculiar moving thoughts, its current forms, from Grecian literature. Homer, Aristotle, and Plato have continued to be the teachers of the peoples till our days.

The balance of decision in this conflict is now swinging hither and thither. Professional interest in the Latin has declined since the Greek writers have been read again in the original, yet the Latin language has remained the principal subject of instruction. Its reach, however, has constantly become less. Since the use of language as such has steadily diminished, we have let rhetoric drop and have limited ourselves more and more to grammar. Indeed, grammatical teaching has gradually become so predominant that even the Latin essay has been reduced to a pious desire. We have thus reached a turning point with the classical languages. Schooling in grammar is not that aid to continuous growth which our youth need. It does not produce that desire to learn which is an essential preliminary to independent advancement; on the other hand, it is evident that it has become an object of aversion to many pupils, and perhaps for more parents. Greek has already been half surrendered. No one expects any longer that the mass of the pupils coming from the schools shall be so far advanced as to be qualified to take up the independent reading and explanation of the Greek writers. Medical men had apparently the most reason for regret, for their science is the only one which has grown up during more than two thousand years uninterruptedly on the basis of the Greek writings. But it can not be denied that Hippocrates and Galen offer so few points of touch with present doctors, although these piously adhere to the Greek terminology, that the study of them is of the least significance to the understanding of pathological processes. The real value of Greek literature, moreover, lies not in its technical parts, but rather in the philosophical and poetical departments, the influence of which in cultivation is for the moment underestimated.

An important innovation has meanwhile taken form in the philological department, which we may proudly praise as eminently a German achievement: I mean the study of comparative linguistics. With it a properly genetic element became valid even in philology. Wonderful results, of inestimable value in the history of human civilization, are now in prospect. Ever new researches keep the probability in view that comparative linguistics will continue to be a regular constituent of the higher education.

But it will evidently be attainable in its details only to university students. The decision of what shall be prescribed to the higher schools concerns, therefore, only the two classical and the modern languages. The university teacher has, in respect to this decision, to insist that, whatever language is prescribed, it shall be so taught that the pupil shall learn to work independently in it, and that he preserve his pleasure in the work. It remains to be seen whether new methods of teaching will promote this object.

We can now show upon this subject that there are other fields of teaching, the methods of which have been so well shaped out that they are in a condition completely to carry out what is needed. They are mathematics, philosophy, and the natural sciences. They have, on the one hand, so rich and diversified a content that they ever stimulate the love of knowledge anew, and on the other hand they are so well adapted to an ever more extensive cultivation as to afford a rich opportunity for genuine research. It is thus made clear that occupation with them affords the young mind so sure a preparatory training that it can make itself at home with peculiar ease in every faculty.

Instruction in the branches we have named, at least in their elements, was introduced long ago in our higher schools. Only the measure of the knowledge which should be prescribed as the purpose of this instruction has been variously fixed at different times. The opinions of teachers as well as of the controlling state officers have frequently changed; and the excessive tendency of these men toward the philological course at last always borne against the extension of the designated branches. Only the extreme necessity of satisfying the demands of the rapidly advancing technical interest and the industries gaining strength evenly with it, irresistibly forced concessions, and when it was believed that these could not be carried in the humanistic institutions, a separation was decided upon. Hence arose the polytechnic schools and the gymnasia, and as a further result the technical high schools.

A final peace has not been reached in this way. Our age is in the midst of the fight over the claims of particular kinds of high schools. The call is ever anew rising for specially organized schools, and before everything for a far-reaching reform of gymnasial teaching. Not all these demands can be justified. The universities have in most cases not sustained the claims of the real schools for a general admission of their graduates. As we have already observed, the interests of the individual faculties in the kind of preparation of their students are not identical. Those faculties which look in their teachings for immediate support in philological aids can not declare themselves satisfied with a preparation which has pushed the ancient languages more or less into

the background. Those to the understanding of whose branches the ancient languages as such contribute directly no essential part have to consider how far a full training in mathematics and science can furnish for their branches and for general cultivation as well an adequate substitute for the want of classical training. Experience has not supplied a decision on this point. It can be remarked only that among the foreigners who have been admitted to our classes are many who have not enjoyed a gymnasial training in our sense, and who yet attend the lectures with commendable interest and with evident good results.

There undeniably exists an essential difference in respect to the demands which individual faculties have to make on the preparation of those coming to them from the schools. The future must teach us whether a single kind of higher schools can satisfy these various demands. But a definite answer can already be given respecting one of them. If the classical languages are no longer competent to supply the unifying bond that formerly connected all the different directions of learned culture, a substitute for them can be found only in that golden triad of mathematics, philosophy, and science on the development of which all modern civilization touches.

It is a matter of secondary importance for this discussion whether the roots of this culture should be sought still further in the East, in Egypt or in Babylonia. The continuity of Western civilization actually begins for us on the western coasts of Asia Minor with those Ionian Greeks who first laid mathematical study of the heavenly bodies at the base of their discussions concerning the universe, and who produced the first natural philosophy, in which all that man knew about Nature was reduced to a harmonious picture. In this philosophy lies the actual beginning of that universal consideration of the world which has been significantly called "world wisdom," and which has gradually led to a fundamental transformation of the old conceptions of the heavens and the earth and of man himself. That is the imperishable title of the Grecian philosophy to be held in honor.

The full comprehension of this fact arose very late among the Western peoples. When, after the fall of Constantinople, Greek scholars fled to Italy, and Greek literature spread rapidly at that time, when the humanists arose in Germany, and one university after another was founded, then the independent spirit of investigation first lifted itself up in all nations. Mathematicians and naturalists abounding in original strength appeared, and philosophers were soon active in adapting the conceptions of men to the new views and in grasping the fundamentals of intellectual life.

Right in the beginning of this memorable period appeared the man whose great achievement mankind has just been festively

celebrating. Day before yesterday it was four hundred years since Christopher Columbus descried the first land of that New World in which now many millions are joyously engaged in commemorating him. For him was the enviable fortune reserved of demonstrating at a stroke, by a bold experiment, the truth of the theory that the earth is round, and of opening at the same time to human enterprise the widest field that had ever been unlocked to it. Let us at this place bring the deserved offering to his genius and his energy. Let us not forget that with him, notwithstanding his mistakes, which have been perhaps made for the moment too prominent, a new era began—an era of new thought and new traffic.

Then mental activity prevailed everywhere; great mathematicians and physical astronomers of the first rank arose; the great reformation in the Church began, and the foundations of modern medicine were laid. We are still in the midst of the movement, but it is victorious everywhere. Our age has been called the scientific age. None of the humanities have escaped this influence. Even the Roman Catholic Church, which endeavored so earnestly to restrain it, has joined it; and an appointed representative of the Evangelical Church, our honored colleague Dillmann, a few years ago spoke in his rectoral address the strong words, "A church which can not bear the light of science, or which has to temper it with colored glasses, should be laid with the dead." In fact, the modern doctrine of the universe is wholly built up on the ground of natural science, and nobody can seriously deny that it must be so.

The question is therefore permissible, whether the youth of our learned schools should not be advanced further than they are now in this new knowledge. It can be readily granted that there are still questions that have not yet been determined among the learned concerning the instruction that should be excluded from the schools and the instruction in specialties that should be reserved for the universities. But we may ask that a young man, credited with self-reliance enough to make good use of academical freedom, shall be in a condition to absorb without danger the leading facts of astronomy and biology. Can he be regarded as really mature when the whole world around him is to a certain extent closed to him? And how can university instruction effectively influence the young man if he is deprived of the instrument he needs in order to carry on his hard work?

He needs mathematics, not for its own sake, and not merely in order that he may understand the motions of the heavenly bodies; even physics has gradually become a mathematical science; and in chemistry and physiology it is becoming more and more necessary to carry out minute calculations. By their aid

the student presses into the comprehension of the inner processes, and learns not only to estimate the measure of the living forces but also to calculate them in advance, in order afterward to adjust the practical using of them.

Arithmetic alone is not enough; thought is also necessary to comprehension. Many conceive that it is not necessary to make thought itself an object of learning; but there can not be success without methodical thinking. Unfortunately, logic is one of the studies that has almost been forgotten. At most of the schools one is supposed to have done enough if he occasionally expresses a logical theorem. How can one pursue psychology who has never become acquainted with the laws of thought? How can the complicated conditions of mental life be made perceptible to the outward view? The young doctor is a little more favorably situated in respect to this matter; but what can be expected of the jurist, the theologian, and the pedagogue? Respect for philosophy is already, at least, cultivated; that is much. The disposition to learn to think philosophically will then easily be yielded to.

And now, finally, the natural sciences. What profitable objects for learning and teaching do the descriptive sciences—botany, geology, and mineralogy—afford! It is a mistake to suppose that university teachers lay most weight on systematic knowledge. Not at all. The systematic method, it is true, is learned at the universities. It does no one harm to be able to learn and distinguish a certain number of plants, animals, or stones. But the instruction proper should consist in the training of the senses, especially of the sight and feeling. At present we have to lament that a large part of our students have no exact knowledge of colors, that they make false estimates of the forms of the objects they see, and they manifest no comprehension of the consistence and exterior constitution of bodies. Nothing should be easier than to cultivate an accurate judgment concerning color and form, if besides the comprehension of the body the representation of it by a simple or colored drawing, though it were only a sketch, were learned. Every one can make such knowledge useful. It is of great value to medical men, for diagnoses of the most important conditions are not rarely dependent upon it.

The experimental sciences, especially physics and chemistry, are also indispensable in school instruction, because more than all other branches they lead to the knowledge of the genetic and causal connection of the processes, and prepare for the methodical consideration of the more difficult problems of biology. It is evident that so long as general preparation for academical studies alone is considered, only the simpler and more easily understood experiments can be dealt with in them. But every pupil who

goes out from the school should still, at least, have been introduced to these methods of studying Nature, in order to obtain a proper faculty of observation.

This enumeration of what belongs to a good preparation has been carried out to a considerable length, not because so many subjects have to be brought forward, but because in the present stage of the discussion of the relation of the university to the preparatory schools, the question of the measure of preparation that should be required for university instruction occupies the first place. In order to avoid mistakes, it may be added that to one who would limit himself to the study of his specialty, much of what has been named above may appear superfluous. But if the purpose was merely to secure a professional training, the universities would be superfluous. Then we might establish, as in France, separate *écoles*, or as in England, special colleges, or as in the Roman Catholic Church, isolated convents. If we regard the university, as is our pride, to be more than an auxiliary to the professional schools, we must also demand an effective interworking of the faculties, a general scientific course by the side of the professional course. If this, to our great regret, does not exist to the extent it ought and might, the blame for it lies in that want of preparation which I have tried to sketch, and the remedy for which I expect to follow a more exact exposition of the actual conditions.

So long as this help is not found there will be nothing left but to take up in the universities much more elementary or, at least, preparatory teaching, which burdens and degrades the instruction, and which, though sufficient in a very few cases, fails to supply the defects of preparation. The university professor has the less time for such teaching, because the university is not merely an institution for learning, but also for investigation. It is that likewise in a double sense: first, because our nation is accustomed to see scientific investigators in the university professors; and, secondly, because the state and science expect us to train at least a certain portion of the students to be investigators. In this sense we call the attendants as well as the institutions of the university academical.

The ancient name of the academy, which has received from Plato the meaning of a school working for the highest objects of mental exertion, has been applied since the times of the Medici to designate, as against the professional schools and the teaching schools, unions of prominent thinkers and investigators for co-operative work. From them have proceeded the academies of sciences. A more recent age has produced besides these all possible sorts of academies which do not concern us here. The continuous investigation of scientific problems is the appointed chief

purpose of only academies of sciences. But there are in Germany only three, at most four such academies, and they are far from sufficient to assure general progress over all the wide fields of science. A part of their function has thus fallen upon the universities, and they have performed it valiantly, sometimes gloriously. This is the reason why German university teachers demand more time than is required for the teaching in itself.

The universities have also an important function in the second direction, as I have said, in the training of new investigators and teachers. This is a very near duty, for only thus can that indispensable constituent of the teaching body, the position of *privat docent,* the nursery for future professors, be maintained and reproduced. Therefore, we should begin early to train independent workers from among the students.—*Translated for The Popular Science Monthly.*

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## PROTECTION FROM LIGHTNING.

By ALEXANDER McADIE.

DURING the year 1891 two hundred and five lives were lost (that we know of) in the United States, east of the Rocky Mountains, *directly* through the action of lightning. How many were lost indirectly, and how many cases there were of shattered health and more or less permanent injury, we can only surmise. The financial loss due directly to lightning was certainly not below one and a half million dollars. To get at something like a commercial estimate of the damage done by lightning in the past few years, in this country, I have made use of the Chronicle Fire Tables for the six years 1885–1890, and find that some twenty-two hundred and twenty-three fires, or 1·3 per cent of the whole number, were caused by lightning, and the total loss was $3,386,826, or 1·25 per cent of the whole amount lost by fire. During 1892 we have a record of two hundred and ninety-two lives lost. The damage may be estimated at as high a figure as in 1891. These losses are the more appalling when we recall that the year is virtually less than six months. Over ninety-five per cent of the casualties due to lightning occur between the months of April and September. It is therefore qutie pertinent at this time to discuss the question whether or not we are able to protect ourselves from lightning. Some five years ago the question would have been answered readily and with all sincerity, "Yes, a good electrical connection with the earth—a stout, continuous copper rod, for example—will suffice." To-day no such answer can pass unchallenged, for reasons which we shall see.

In 1888, after years of dispute, we had just settled down to the

calm enjoyment of the belief that rods did protect. The Lightning-rod Conference had shown, in quite an exhaustive report, that Faraday's position (as opposed to the opinions of Harris) was correct, viz., that the problem was one of simple conductivity; that a solid rod was better than a tube or tape (which would give greater surface with less copper); that solid volume was everything, superficial area nothing; and that, provided the metallic passage afforded the flash was continuous, any flash might be successfully carried off and harmlessly conducted to the ground.

This conference, while not strictly an official body, was one that, from the character of its members, carried great weight. It was a joint committee of representative members of the Institute of British Architects, the Physical Society, the Society of Telegraph Engineers and Electricians, the Meteorological Society, and two co-opted members.

In 1888 came Dr. Oliver J. Lodge's remarkable course of lectures before the Society of Arts upon the oscillatory character of the lightning flash.. Then followed the famous dicussion at the meeting of the British Association. As this debate was one in which quarter was neither asked nor given, and the question at issue was clearly understood by all to be whether a lightning conductor, when constructed in accordance with the directions of the conference, would absolutely protect, it may not be out of place to give here a synopsis of the arguments advanced. Mr. Preece, who opened the discussion, defined the functions of a lightning conductor as twofold. "It facilitates the discharge of the electricity to the earth, so as to carry it off harmlessly, and it tends to prevent disruptive discharges by silently neutralizing the conditions which determine such discharges in the neighborhood of the conductor. To effect the first object, a lightning conductor should offer a line of discharge more nearly perfect and more accessible than any other offered by the materials or contents of the edifice we wish to protect. To effect the second object, the conductor should be surmounted by a point or points; fine points and flames have the property of slowly and silently dissipating the electrical charges; they, in fact, act as safety valves. If all those conditions be fulfilled, if the points be high enough to be the most salient features of the building, no matter from what direction the storm cloud may come, be of ample dimensions and in thoroughly perfect electrical connection with the earth, the edifice, with all that it contains, will be safe, and the conductor might even be surrounded by gunpowder in the heaviest storm without risk of danger. All accidents may be said to be due to a neglect of these simple elementary principles. The most frequent sources of failure are conductors deficient either in

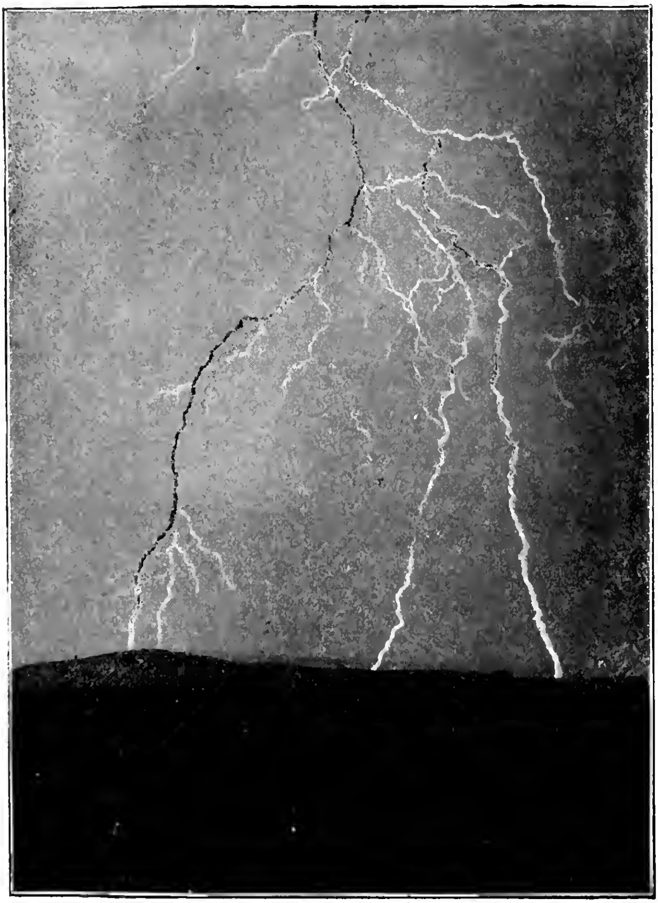
number, height, or conductivity, bad points or bad earth connections; . . . and there was no authentic case on record where a properly constructed conductor failed to do its duty. . . . He personally had under his supervision at that present moment 500,000 lightning conductors, and, fixed throughout the offices (post-office

LIGHTNING CLOUDS, MULTIPLE FLASH.

and telegraph), had apparatus, protected by about 30,000 or 40,000 lightning protectors."

Dr. Lodge said that "if his views were correct, very few buildings are effectively and thoroughly protected at the present time. . . . He had read carefully the Conference Report, and found a large number of entire failures; . . . one noteworthy one, a brass rod an inch thick on a steeple which was smashed to pieces and the spire destroyed. Again, the best protected building in the world, the Hôtel de Ville at Brussels, on which M. Melsens had

spent so much time and trouble. It was elaborately protected; protected by innumerable conductors with admirable earths made in a variety of ways, bristling with points all over the top—everything carried out in the most approved style, regardless of expense. Yet in the month of June the building was struck and set on fire. . . . If a lightning conductor can prevent a flash from occurring by its repellent action, well and good; but he had



Multiple Flash.

shown in his lectures that there are cases where a point has no protective action whatever, when a point could be struck by a thick and heavy flash. There were other cases where the point acts with a brush or fizz and neutralizes the electric charge without a flash. They could not always do it. And so the lightning rod has two functions; one is to be repellent if it can, and the other is to carry off a flash when it can not help receiving it.

There was a certain amount of energy which they must dissipate somehow, and they could not expect to *hocus pocus* it out of existence by saying they could conduct it to the earth. The quicker they tried to conduct it down to the earth the more searching and ramifying disturbances they were likely to get. It might be better to let it trickle down slowly by using a moderately bad conductor than to rush it with extreme vehemence down a good conductor, just as it would be safer to let a heavy weight suspended in a dangerous position down slowly rather than let it drop as quickly as possible. . . . If a man holds a lightning conductor when a flash passes down it, he will most likely be killed. . . . It did not matter about the earth: . . . a spark was likely to occur . . . he had made experiments in the laboratory with a rod very thick and a yard long, in circuit with a Leyden-jar discharge. He took a platinum wire as fine as possible to make the contrast greater, and arranged it so as to make a kind of tapping circuit; if, then, the bottom end was arranged so as to be in contact with the rod and then let the top end be an eighth of an inch away, then they would have a splendid conductor, better than any lightning conductor ever was. They would have no trouble about earth. It seemed absurd for any portion of the discharge to leave this conductor to jump across and make for the little strip of wire. Nevertheless, a portion of it did, and from every spark that went to the conductor, a side branch went to that little wire. . . . What are the conditions of a flash? He assumed that a flash behaved like experiments in the laboratory, but it was a question whether a cloud discharge was of this kind. A cloud is not like a conductor; it consists of globules of water separated from one another by interspaces of air: it may be compared to a spangle jar: when a spangle jar discharges, you have no guarantee that the whole of it discharges—it discharges in a slowish manner. It might be that there was with a cloud first a bit of a discharge and then another bit, and so on, so that there might be a kind of dribbling of the charge out of it, and they might therefore fail to get these sudden and oscillatory rushes. . . . But we must provide for the possibility of a sudden discharge."

Hon. Ralph Abercromby contributed to the discussion facts brought out by an examination of some ninety photographs of lightning flashes in different parts of the world. In one instance the whole air was filled with threads of lightning coming down like the roots of a tree from the sky. He thought it was very much a question where the area of protection would be when the whole air seemed to be pouring lightning down upon you. He would also like to find out whether buildings were struck during rain or when it was not raining. In connection with the fact that thunderstorms were confined to the lower ten thousand

feet of the air, he mentioned the fact that in Norway there were two kinds of thunderstorms: one occurred in the summer, he believed, when the lightning clouds were high, and very little damage was done; on the contrary, in winter time the clouds were very low, and the churches were frequently struck.

Lord Rayleigh, Sir William Thomson, and Prof. Rowland discussed the questions whether or not the experiments actually represented the actual conditions. M. de Fonveille called attention to the most extraordinary lightning conductor in existence, the Eiffel Tower, and the fact that Paris was practically free from calamities produced by lightning, because a sufficient number of lightning rods had been erected according to the principles advocated by the many official boards, substantially the same as the conference. Prof. George Forbes thought a copper alternative path better than an iron one. Sir James Douglas, speaking from an experience of forty years with a large number of conductors, was of the opinion that the rods, when properly constructed, were entirely adequate. In the matter of copper *versus* iron he pointed out the practical consideration that iron corroded rapidly compared with copper. Mr. Walker further pointed out that this corrosion of iron was not a question of weather alone, but, as in the case of the top of the chimney of a factory, there would be some chemical action. Mr. Symons brought out with respect to iron conductors that galvanizing would not entirely overcome the difficulty.

We now come to Lodge's book upon Lightning Conductors and Lightning Guards, and shall get from it a more satisfactory understanding of his experiments and deductions. He believes that the current ideas on the character of the lightning discharge were not altogether correct, because the momentum of an electric current and the energy of an electrostatic charge had both been more or less overlooked. The application of the known fact of electrokinetic momentum revolutionized the treatment of certain phenomena. The old drain-pipe idea of conveying electricity gently from cloud to earth was thus proved fallacious, and the problem of protection became at the same time more complex and more interesting. His position, therefore, is not that lightning rods are useless, but that few or none of the present types are absolute and complete safeguards; and he believes it possible to so modify existing protective systems as to afford more certain protection. The problem is one, he very clearly shows, far removed from the old idea of conduction.

To-day we know from the experiments of Hertz, Lodge, and others that when an electric current flows steadily in one direction in a conductor, its intensity is the same in all parts of the wire; but if it be of an oscillatory character—i. e., a current revers-

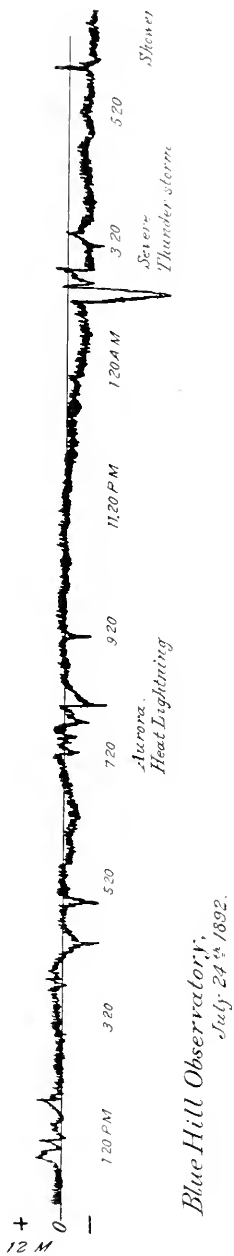
ing rapidly in direction—the interior of the conductor may carry far less than the surface carries.

All of which goes to prove the correctness of Snow Harris's opinion (and he probably studied the effects of lightning more exhaustively than any one else) that surface was more of a consideration in the form of a protector than solid section. In this matter of the form of a conductor we follow Lodge, and prefer

IMPULSIVE RUSH DISCHARGE. SO-CALLED DARK FLASHES.

the tape to the solid rod. Increase of surface diminishes impedance; and as impedance is probably at the bottom of side flashes and spittings, that conductor is to be prefered which offers less impedance, and hence tape appears to be preferable to rod. It is also more convenient, and it has also the advantage of being made either continuous or in very long lengths. The tape must be of dimensions sufficient to withstand melting or deflagration.

"Think now," says Lodge, "of a cloud and of the earth under it as forming the two coats of a Leyden jar, in the dielectric of which houses and people exist; we now have to consider what determines a discharge, and what happens when a discharge occurs. The maximum tension which air can stand is one half gramme weight per square centimetre. At whatever point the electric tension rises to this value, smash goes the air. The breakage need not amount to a flash, it must give way along a great length to cause a flash; if the break is only local, nothing more than a brush or fizz need be seen. But when a flash does occur it must be the weakest spot which gives way first—the place of maximum tension—and this is commonly on the smallest knob or surface which rears itself into the space between the dielectrics. If there be a number of small knobs or points, the glows and brushes become so numerous that the tension is greatly relieved and the whole of a moderate thunder-cloud might be discharged in this way without the least violence. . . . But sometimes a flash will descend so quickly or it will have such a tremendous store of energy to get rid of that no points are sufficiently rapid for the work, and crash it all comes at once. One specially noteworthy case is when one cloud sparks into another and thence to the ground; or in general whenever electric strain is thrown quite suddenly upon a layer of air."



Curve showing Electrical Potential of the Atmosphere.

Thus, then, we begin to see that much will depend upon the character of the flash. There are many flashes, I believe, that the body could experience without very serious consequences; and there are many that will rive solid granite and shatter in splinters the heaviest masonry. The impulsive rush discharge shown on the preceding page was doubtless a flash of the latter character; and on the other hand, with a kite in air during thunderstorms with a wire connection to the ground I have experienced sharp shocks with lightning

flashes, which were perhaps side branches or minor spitting-off discharges.

The risk, then, will vary with the discharge, and this is influenced somewhat by locality, and therefore the methods of protection to be employed in the Mississippi Valley would be somewhat different in character from the methods appropriate for, say, the New England coast; the frequency of thunderstorms in the one place compared with the other being about four to one. The character of the storm is also somewhat different. Then again the liability for places comparatively near is not the same. "If I urge on Glasgow manufacturers," said Sir William Thomson, "to put up lightning conductors, they say that it is cheaper to insure." These manufacturers answered the man of science more wisely perhaps than they themselves knew. Thanks to the investigations of the Prussian Bureau of Statistics, we know now that *in the main* in thickly settled communities the risk is small. We can state with some certainty that there is but little need for the erection of expensive or elaborate lightning rods upon buildings standing among others in city blocks. We do not say that such buildings are never struck. As we have seen above, under some conditions, "exposure" seems to have little to do with the determination of the path of discharge. The case is somewhat analogous to that of the trees and rocks upon a mountain side. However much they may determine the course of small streams and "trickles" down the mountain side, they are powerless to influence the course of an avalanche or land-slide. Sometimes, therefore, such buildings are struck and severely injured (and as might be expected, with seemingly good protectors, do not entirely escape); but these cases are rare, and it may, we think, be safely set down that rods upon city houses are not (as hitherto insisted upon by some) necessary. With country houses the conditions are different.

Our next question is, In flashes of ordinary intensity how much confidence may be placed in the protection afforded by a good conductor, rod or tape? Few questions have been so thoroughly discussed from a practical standpoint, and the verdict may be given in Sir William Thomson's words: "There is a very comfortable degree of security, if not of absolute safety, given to us by lightning conductors made according to orthodox rules."

If the reader is contemplating the erection of a lightning protector, these points may be of service to him:

1. Get a good iron or copper conductor of rod or tape form, preferably the latter. If copper, have it weigh about six ounces to the foot; if iron, about two pounds to the foot.

2. The nature of the locality will determine to a great degree

the need of a rod. In some localities rods are imperative; in others, needless.

3. The very best ground you can get is, after all, for some flashes, none too good; therefore do not imagine that you can overdo it in making a good ground. For most flashes ordinary "grounds" suffice; but the small resistance of even one ohm may be dangerous with an intense flash.

4. "If the conductor at any part of its course goes near water or gas mains it is best to connect it to them. Wherever one metal ramification approaches another it is best to connect them metallically. The neighborhood of small-bore fusible pipes and indoor gas pipes in general should be avoided."—*Lodge.*

5. The top of the rod should be plated, or in some way protected from corrosion and rust.

6. Independent grounds are preferable to water and gas mains.

7. Clusters of points or groups of two or three along the ridge rod are recommended.

8. Chain or link conductors are of little use.

9. Area of protection. Very little faith is to be placed in the so-called area of protection.

10. Indifference of lightning to the path of least resistance. Nearly every one who has written in late years has taken it for granted that lightning always follows the path of least resistance. This is not true. "It is simply hopeless to pretend to be able to make the lightning conductor so much the easier path, that all others are out of the question," says Lodge. This, however, requires modification. For the path will depend largely upon the character of the flash; and without doubt, for almost all flashes, a good lightning rod well earthed is the most appropriate path to earth.

11. Any part of a building, under certain conditions, may be struck, whether there is a protector on it or not. There are cases on record where edifices seemingly amply protected have been struck below the rods (not cases of defective connection), and it is now beginning to dawn upon us that (paradox of paradoxes) a building may be seriously damaged by lightning *without having been struck at all.* The Hôtel de Ville, at Brussels, perhaps the best protected building in the world against lightning, was damaged by fire, caused by a small induced spark near escaping gas. During the thunderstorm some one flash started up "surgings" in a piece of metal not connected in any way with the protective train of metal. "The building probably did not receive," says Dr. Lodge, "even a side flash, yet the induced surgings set up in it were so violent as to ignite some gas and cause a small fire." In other words, we had the condition of an "oscillator" in the cloud-flash-earth and a "resonator" that responded with its little spark.

In some experiments which we made last summer, simultaneously with some flashes, we got little sparks from a wire in the air.

12. So many people suffer so keenly from a kind of nervous alarm during thunderstorms that it is a great pleasure to be able to point out that the danger is vastly overestimated. "Heaven has more thunders to alarm than thunderbolts to punish," was the old irreverent way of putting it. One who lives to see lightning need not worry about the results.

13. The notion that lightning never strikes twice in the same place is erroneous. We have numerous cases disproving this.

14. If you are near a person who has been struck by lightning, go to work at once to try and restore consciousness. Try to stimulate the respiration and circulation, and do not cease in the effort to restore animation for at least one hour.

## SUCCESS WITH SCIENTIFIC AND OTHER MEETINGS.

By GEORGE ILES.

NO tendency of these times is more marked than that toward organization. It manifests itself as plainly in scientific inquiry, literary investigation, or the cultivation of art as in the sphere of industry or finance. Let chemistry, folk lore, or musical education engage the minds of a group of people, and forthwith they unite themselves to further the interest they have at heart. The societies thus created have often manifold utility; they provide rallying centers for men and women of kindred aims, whether these aims are of popular acceptance or not; they make possible a co-operation which economizes the labor of observation or research; they furnish agencies for the spread of information accessible nowhere else; in their "proceedings" or "transactions" they publish valuable papers which otherwise would never see the light of day, and often these volumes are the sole registry of progress in important branches of inquiry or revolutionary reform. The public mind may be profoundly exercised concerning a wrong or a grievance, but its discontent is powerless until, let us say, a Free-trade League is born to serve as a nucleus around which public opinion can crystallize, which will gather and clarify argument to be echoed by a thousand friendly voices, and which will press its fight at every opportunity. Only in this way can an interest which concerns everybody only a little tell in legislation against a much smaller interest which concerns a few plunderers a great deal.

Of course, the meeting of a league or a society, whatever its objects, is determined in character by that of the organization

itself. If a purpose really worthy has prompted to union, if, avoiding faction, the best men have been put at the head, there is no reason why attractive and profitable meetings should not be held. On success here largely turns the success of the organization, for meetings should not only interest the membership, but also the general public from whom support is sought, from among whom recruits for active service must come. The judicious management of such gatherings is therefore a matter of some moment, and it well deserves more attention than it commonly receives.

Of scientific bodies in the United States, one of the oldest and in many respects the most typical is the American Association for the Advancement of Science, whose meetings in the main have been the most popular scientific assemblies held in this country. The association has suffered severely, and inevitably, by the establishment of many societies for the prosecution of branches of science, electrical, engineering, and what not, which scarcely had a name at the time of the association's nativity, fifty-three years ago. Then, too, the formation of the National Academy of Sciences has drawn off certain of the veterans who fail to recognize the claims of the association on their allegiance, who neglect the opportunity the association affords to repeat the last word of discovery to the people. A wide variety of societies for the promotion of this aim or the suppression of that evil have done well to follow the association's lead in one or two directions. First, in hospitality to all in sympathy with the object sought to be furthered, without asking the candidate for membership what he knows or what he has done. Of course, societies for advanced study, such as the Societies of Morphologists and Anatomists, can not set before everybody this open door, but bodies for work less specialized find their account in creating honorary or associate memberships which broaden their foundations in public sympathy and support; especially is this result desirable where the research promoted is, let us say, astronomical, and bears in the market-place no price.

The American Association, too, has set a good example in migrating from place to place year by year, so as to kindle the widest possible interest. To cite a case where visits of this kind have borne fruit, Montreal has within the past ten years been enriched by benefactions for education which give her rank with the most highly favored cities of the continent. These foundations, and the local response to the opportunities they offer, are in no small measure traceable to the important scientific meetings held since 1881 in the Canadian metropolis. In Canada, as in the United States, there is much sound sentiment regarding the fast-disappearing woodland wealth. This sentiment is largely to be

credited to the American Forestry Association, a comparatively small body, which, in its peregrinations north and south, and east and west, has brought many thousands of people to its way of thinking, and with them not a few of their lawmakers. In 1891 Congress authorized the President to set apart as a reservation any public land wholly or in part covered with trees; in two years this law has recovered tracts aggregating twelve million acres. For the proper forestry administration of these and other lands of the Federal Government the association is the only organized means of agitation in the country. Perhaps one reason why the American Social Science Association does not exert the influence it merits is that its gatherings always take place in Saratoga; this, too, while its British prototype observes the rule of itineracy. Even the National Academy of Sciences, whose investigations are of the most recondite order, migrates for one of its semi-annual meetings. To take the example of an industrial organization that keeps to the road let the National Electric Light Association be named: its tours throughout the land serve to refresh men devoted to an arduous profession; in their examination, on these tours, of all kinds of electrical installations practice everywhere tends to rise to the level of the best; and wherever the association goes it gives a local stimulus to the interest in Nature's master force in all that it means for the relief of toil and the refinement of life. When an organization to promote science pure or applied is put on wheels another advantage arises: its visits to a chain of towns and cities rarely fail to bring out a good deal of amateur talent—confirming tastes and talents which do much to cheer their possessors amid the drudgery of office or shop. The trained inquirer may look askance at the amateur, but it is well to remember that Dr. William Huggins, the President of the British Association in 1891, an astronomer who has notably furthered the science and art of stellar spectroscopy, calls himself but an amateur; Mr. Thomas D. Anderson, of Edinburgh, another amateur, last year discovered the new star in Auriga so earnestly discussed as probably confirming the meteoritic hypothesis of stellar accretions; an amateur, too, it was who, in the person of James Prescott Joule, first ascertained the mechanical equivalent of heat, the basis of the doctrine of the conservation of energy. In no infrequent case an intellectual man of leisure, who has not yet formed habits of idleness, has had a genuine and lasting interest aroused by the advent of a learned or scientific society in his neighborhood.

While the advancement of science is the stated purpose of the American Association, it has accomplished much else that could ill have been spared. It has periodically brought together old friends whom the exigencies of professional or business careers

have separated by the breadth of great States or even by the width of America. Its social meetings have often been as gainful as delightful. Here the youth just across the threshold of geology or astronomy has met the veteran explorer or observer, and thenceforward his work has known the ardor of discipleship; there are men now eminent in American science who recall as among their first inspirations the noble and kindly faces of Henry, Gray, Guyot, and Agassiz at association meetings. There is always a good deal in the mind of a man of science that he does not care to commit to a formal report or a dignified text-book; his appraisals of the current literature of his special field, his suggestive criticisms of the latest audacities of theory, his shrewd guesses as to what next awaits the discoverer, are only for those who meet him face to face. Not seldom a thinker or an experimenter in a remote corner of the country cherishes a hypothesis or proposes an apparatus intended to solve an old difficulty in a new way. At an association meeting he finds the mechanician or the chemist, who of all men can best disabuse his mind of its harbored fallacy, or point out how for success his project must be modified. And many men prosecute masterly work at lonely outposts, or, worse still, in populous centers of uninterested people; they are spared a withering sense of isolation in finding at the yearly muster that it is after all a goodly army in which they are enlisted. In so far, too, as the association has managed to keep specialists of eminence in its ranks, they receive at the annual assemblies not less benefit than the tyros. The observer with microscopic slides or test-tubes constantly at his eye is refreshed when he meets at the council table and the general session his peer of the geologic hammer or the telescope. Nor must the benefits be forgotten which the association has conferred upon men of affairs drawn into its audiences and interested in its work. They have seen somewhat of the unselfish labor in breaking new ground which must go before the sowing and reaping we know as industry and business. Hence have arisen generous gifts for research—which might well be multiplied; and, apart from any question into which gain or gift can enter, the association has done noble work in bringing to the people a glimpse, at least, of that inspiring ray which ever gilds truth as it emerges from the unknown.

Much that can be said of the good born of this association's meetings is true of those of many societies for research, education, or reform, which year by year and almost month by month spring into existence. Let us glance at one or two cases where a small band of earnest men have been able to do great things, not for science, but for righteousness. The Civil-service Reform Association, founded by George William Curtis and his friends

in 1881, has in its agitation of twelve years been the chief agency at work in combating the claim that "to the victor belong the spoils." To-day one fourth the offices in the gift of the Federal Government are subject to reform rules, with promise that at no distant day "the aristocracy of 'pull' shall make way for the democracy of merit." Mr. Curtis and Mr. Schurz, in their stirring addresses from the chair of the association, have reached audiences a thousandfold greater than those within sound of their voices; the press has made the Rocky Mountains their back benches. Against another iniquity battle was waged, in 1883, when the Copyright League took form. The league began as a handful of men, few of them rich or influential, attacking a compact and well-armed pirate crew and a solid mass of unsound public sentiment. Within eight years the people were brought to preferring to a cheap book a book honestly come by, Congress passing a bill declaring that literary property is property still, even when a foreigner creates it. The league in its series of authors' readings given in the principal cities of the Union had a magnet of uncommon power, evoking vastly more interest in the cause of international justice than any set arguments could have done. It is only fair to say that the agitation which the league inherited dated back to 1837; it may be worth while to add that the money cost of the league's work was but ten thousand dollars.

Not the least of the attractions which Chicago offers her visitors this year is her programme of congresses. Associations educational, industrial, scientific, and philosophical are assembling in the Western metropolis in rapid succession and under circumstances in which the art of their management can easily be carried a step further than in any past achievement in America. The local committees for the reception of visiting bodies will have more or less permanence, and will therefore through experience grow proficient, an exceptionally large number of the well informed and inquiring can be drawn upon from the throngs attending the fair, and the manifold departments of the exhibition will furnish in profusion illustrative material of rare quality. Hon. C. C. Bonney, chairman of the World's Congress Auxiliary, is in permanent charge of the congresses convened during the Columbian Exposition. He supervises the working details of each special committee; and his chief aim in his work is that relations among the leaders of thought and action which hitherto have been only local, shall henceforth become international.

To those whose duty it is to attend meetings, scientific and other, remarkable contrasts in their management are familiar. The success of a meeting is earned only by a business-like control, which makes thorough preparation months beforehand. The

executive board, by whatever name it may be called, should be a body of competent, resourceful, and hard-working men. Their main task is to insure good addresses and papers; however little of a speechmaker a man may be, he always talks willingly and acceptably on a subject he has mastered and which is dear to his heart; for papers a selection is usually feasible from manuscripts voluntarily offered, but it is ever found that the one way to have interesting themes treated by the busy people who have a first-hand knowledge of them is by tactful and timely solicitation.

How grievously have audiences, learned and unlearned, suffered from the coarseness of the sieve through which papers are commonly sifted! At the Toronto meeting of the American Association, in 1889, I heard a paper which, admittedly, had been published five years before. It is a case all too frequent that a paper is prolix or trivial, or covers ground thoroughly familiar, or that its writer imagines dilution to be simplification. A very ordinary offense is the technical description or argument which wears its bones outside and spares its victims no jot of anatomical detail. In securing contributions of high value the American Economical Association sets a shining example. Jointly with the International Statistical Institute it will hold sessions in Chicago from September 9th to 16th; all the principal papers were arranged for months ago by the committee in charge. When a writer is in this way given abundant time to prepare his manuscript he can do justice to the public and to himself; he has opportunity to secure publication in an appropriate journal or review, an important point to people who have only their pens to live by. The presidents of the American Association for the Advancement of Science are chosen two years and the presidents of its sections one year before the delivery of their addresses; with this ample time for elaboration and revision contributions to scientific literature of the highest rank have been secured. At the Boston meeting of 1880, the most interesting ever held by the association, Prof. George F. Barker gave his address on Modern Aspects of the Life Question, a luminous summary of progress in physical, physiological, and psychological science, which, enriched with its numerous references, can still serve the student as a guide post. Prof. S. P. Langley, at Cleveland in 1888, outlined in masterly fashion the history of the doctrine of radiant energy. Two years later, at Indianapolis, Dr. Frank Baker traced The Ascent of Man in an address which is a model scientific statement made plain and clear. While its addresses from the chair have usually been excellent, in providing popular lectures the association has left much to be desired. Here it has a good deal to learn from its British namesake, which well understands how a discourse, by interesting the community visited as well as

the visitors, can in some degree requite the debt of hospitality. In their main outlines the conquests of science, in the hands of a skilled exponent, never fail to awaken the enthusiasm of popular audiences. To the essential democracy of the sympathies of research, conceived on broad lines, let the thousands testify who have seen Prof. E. S. Morse at the blackboard busy with both hands tracing the development of birds from reptilian forms, or Prof. E. E. Barnard, of Lick Observatory, as he has thrown on the screen images of myriad stars seized in new spheres of space only through the exquisitely sensitive and tireless eye of the camera.

There is sound policy as well as justice in the sedulous cultivation of points of contact between every-day interests and the highly specialized work which only remotely may issue in a utility. A chemist may be enabled to experiment on di-nitro-sulpho-phenol, and publish his results, because an intelligent manufacturer has through the labor of chemists found a market for coal-tar products, or furnace slag, once thrown away. The links between science pure and applied might well receive more illustration at scientific gatherings than they commonly do. In carefully maintaining its features of popular instruction in this and other respects, the British Association has done much to win its long-sustained pre-eminence. To what else can that primacy be attributed? To its continuity of work and supervision the year round. Its committees, some fifty in number, are charged with investigations, botanical, zoölogical, and other; they confer as to standards of measurement and establish them; they ascertain the properties of solutions, or consider electrolysis in its physical and chemical bearings. All this labor is constantly enrolling new workers, and enabling the officers to appraise the talents and availability of workers new and old. At the meetings he must be a specialist indeed who does not find his particular study illuminated in the committee reports.

Be the object of a society what it may, on the programme of a meeting the main items, of course, are the addresses and papers. When by seasonable solicitation these latter are in hand, printed copies of them, subject to revision, can be distributed prior to their being formally offered. This plan, adopted by the American Institute of Mining Engineers and a few other organizations, should become general. It saves time at a session, where only abstracts need be presented; or, where the writer of a paper can instead of an abstract, give in an extemporaneous word the gist of his manuscript, the printing a paper in advance gives those who are interested in its subject the information needful for comment and criticism. Discussion is of the very essence of a meeting's value, and the institute just named always endeavors

that engineers of mark shall offer their opinions on the papers presented. In the planning of such discussion lies a way of escape from the narrowness and sterility which ever threaten specialization in its modern extremes.

It has often been suggested that some broad question, as the probable age of the earth, be considered at a joint meeting of all the sections of the American Association. Physicists, geologists, and naturalists vary by millions of years in their estimates of the length of our planet's life. The surveys of the special sciences into which, for convenience' sake, inquiry here is parceled out, plainly do not fit together as the parts of an accordant map. Clearly there is need of more light, of exploration of intervening and debatable territory, of new and reconciling generalization. It is in its untraversed border lands, rather than in its measured and cultivated areas, that science has promise and inspiration for the investigator. Discussions are difficult to arrange, and in the ordinary case are unsatisfactory, but in overcoming the obstacles to assigning the specialist a part in the orchestration of high inquiry is rescue from the danger that in the minute study of details their value in constructive thought, in mutual illumination, may be forgotten. At this point re-enters, too, the ever desirable feasibility of interesting the general public, of making the people feel that here and there stand open doors between the questions which come home to them and the fields tilled by men of research.

This matter of interesting the public can at times find its opportunity when the programme is elastic enough to admit the treatment of a question of moment which springs up after the programme has taken form. Last August the American Economic Association met at Chautauqua; most of those who took part in its sessions passed at Buffalo through files of State militia guarding the trains against strikers and rioters. The programme, an excellent one, from the inevitable absence of men expected to read papers, could not be fully carried out. Here was a chance for leading teachers in politics and economics to express themselves regarding a battle between capital and labor pitched in the very neighborhood; outside the session hall, scarcely anything else was talked about; within the hall, Buffalo might have been in Asia for all the attention it received. Can men of science of the academic type wonder at their lack of popular influence when they thus ignore the world of action and passion they live in; when they speak and write mainly at one another, and usually in a language hardly comprehensible to common people when they happen to overhear it? It strikes observers in New York that the power of its corrupt rulers has arisen in no small degree because the leaders among them have been fortunate or shrewd

enough to share the every-day interests of every-day people. Whether from limitation or choice, no sachem of Tammany is ever so far ahead of his followers as to be hidden from them by the curvature of the earth. A teacher of political economy in a leading American university declares that the man politically most influential in this country is the bar-tender; if so, what political text-book or society for political instruction has ever reckoned with him?

A few of the more noteworthy organizations which meet statedly, publish their discussions as well as their papers—a praiseworthy and useful thing to do. This plan is adopted by the American Library Association, a body which renders invaluable service to public libraries, and hence to popular education. The papers to be read at its next meeting, at Chicago, July 13th to 22d, have been assigned to representative men and women in such wise that published as a volume they will form a complete handbook of library economy. This introduction of a comprehensive purpose in gathering contributions that otherwise might be disconnected and desultory is an idea well worth transplanting wherever admissible. The Library Association owes its origin and success in large measure to a secretary of uncommon ability and energy, fertile in ideas and indefatigable in giving them effect. This year he is president. An efficient executive officer is indispensable in arranging the details for a successful meeting. With the principal papers and discussions arranged for, he pays a preliminary visit to the place of meeting. He makes sure that the sessional halls are convenient, ample, and suitably furnished and served; that, if need be, stereopticon views can be properly shown, and that hotel and other quarters are in readiness. He confers with the reception committee, whom he finds not only willing but anxious that out of the fullness of his experience of shortcomings he shall freely speak. He sees that the printed matter of his association is put where people can get it. If, as the civil-service reformers do, he distributes a "primer," it does not fail to say how one can join the organization that sent it forth. He coöperates with the local press in telling the community what people of eminence or note are coming, what they are eminent or notable for, and what they mean to read and discuss. Aided by having the principal papers in print, when the meeting takes place he is enabled to insure fullness, or at least correctness, in the press reports of sessions, remembering that many more will read these reports than can come to session halls. Each day, as early as he can, he takes pains to send to the newspapers the next day's programme. He engages a stenographer to take down the discussions; they may not be published, but they are worth keeping on record, if for no other reason than that they show

how hard it is to get a new idea into people's heads. In brief, this officer is as zealous in attracting audiences, in arousing communities, in promoting the aims of his society, as if he were a man of business creating a market for profitable wares, or a missionary spreading gospel light. Let us note a case or two where the lack of such an officer in the receiving or visiting body has been felt. At Rochester, last August, the American Association was tendered a reception in an art gallery on the upper floors of an office building. Its owner was in Europe, which doubtless accounted for the catalogues of the collection being not lent but sold to his guests, while a staring sign announcing, "To the steel tower—ten cents," was permitted to remain uncovered. At Rochester, too, a city famous for its nurseries, it never occurred to the local committee that visitors would be glad to see these nurseries. Their gates, of course, stood open, yet a very little trouble taken to provide informed guides at a stated time would have added much to the profit and pleasure of a visit. During the week of last Christmas the American Psychological Association met at the University of Pennsylvania. Its first session was held in an upper room of the main building, the second took place in another building some distance off. Because there was no public notification of this change of place, a score of members, teachers, and reporters wasted an afternoon, and missed the presidential address which three of them had come a hundred miles to hear. A few years ago the American Institute of Mining Engineers met at Lookout Mountain. One of the party was the late Thomas Sterry Hunt, an ex-president. In an address which could only come from a master in both chemistry and geology, he described the history of the region at his feet. As he spoke, the conclusions of many thoughtful years were compressed into his pithy sentences. Because he had prepared no notes, and because no stenographer was engaged, that masterly discourse is now only a fading memory.

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M. Lionel Décle, who has lately returned from the Zambesi region in Central Africa, recently visited the underground lake of Sinoie. He describes it as presenting one of the most wonderful specimens which can be given to man to contemplate on the globe. The water is remarkably blue, far more so than that of the blue grottoes of Capri.

Giving his personal and political reminiscences in a recent address, Sir John Lubbock said that he took the first photograph (rather daguerreotype) ever taken in England. Daguerre was a great friend of his father's, and, when he had completed the invention, sent him over a lens with complete apparatus. Sir John, who was then a very small child, was told to remove the cap, and, doing so, achieved the feat.

# PROFESSOR WEISMANN'S THEORIES.*

By HERBERT SPENCER.

APART from those more special theories of Prof. Weismann I lately dealt with, the wide acceptance of which by the biological world greatly surprises me, there are certain more general theories of his—fundamental theories—the acceptance of which surprises me still more. Of the two on which rests the vast superstructure of his speculation, the first concerns the distinction between the reproductive elements of each organism and the non-reproductive elements. He says:

> "Let us now consider how it happened that the multicellular animals and plants, which arose from unicellular forms of life, came to lose this power of living forever.
>
> "The answer to this question is closely bound up with the principle of division of labor which appeared among multicellular organisms at a very early stage. . . .
>
> "The first multicellular organism was probably a cluster of similar cells, but these units soon lost their original homogeneity. As the result of mere relative position, some of the cells were especially fitted to provide for the nutrition of the colony, while others undertook the work of reproduction" (Essays upon Heredity, p. 27).

Here, then, we have the great principle of the division of labor, which is the principle of all organization, taken as primarily illustrated in the division between the reproductive cells and the non-reproductive or somatic cells—the cells devoted to the continuance of the species, and the cells which subserve the life of the individual. And the early separation of reproductive cells from somatic cells, is alleged on the ground that this primary division of labor is that which arises between elements devoted to species-life and elements devoted to individual life. Let us not be content with words but look at the facts.

When Milne-Edwards first used the phrase "physiological division of labor," he was obviously led to do so by perceiving the analogy between the division of labor in a society, as described by political economists, and the division of labor in an organism. Every one who reads has been familiarized with the first as illustrated in the early stages, when men were warriors while the cultivation and drudgery were done by slaves and women; and as illustrated in the later stages, when not only are agriculture and manufactures carried on by separate classes, but agriculture is carried on by landlords, farmers, and laborers, while manufactures, multitudinous in their kinds, severally involve the actions

* A postscript to the essay on The Inadequacy of "Natural Selection."

of capitalists, overseers, workers, etc., and while the great function of distribution is carried on by wholesale and retail dealers in different commodities. Meanwhile students of biology, led by Milne-Edwards's phrase, have come to recognize a parallel arrangement in a living creature; shown, primarily, in the devoting of the outer parts to the general business of obtaining food and escaping from enemies, while the inner parts are devoted to the utilization of food and supporting themselves and the outer parts; and shown, secondarily, by the subdivision of these great functions into those of various limbs and senses in the one case, and in the other case into those of organs for digestion, respiration, circulation, excretion, etc. But now let us ask what is the essential nature of this division of labor. In both cases it is an *exchange of services*—an arrangement under which, while one part devotes itself to one kind of action and yields benefit to all the rest, all the rest, jointly and severally performing their special actions, yield benefits to it in exchange. Otherwise described, it is a system of *mutual* dependence: A depends for its welfare upon B, C, and D; B upon A, C, and D, and so with the rest: all depend upon each and each upon all. Now let us apply this true conception of the division of labor to that which Prof. Weismann calls a division of labor. Where is the *exchange of services* between somatic cells and reproductive cells? There is none. The somatic cells render great services to the reproductive cells, by furnishing them with materials for growth and multiplication; but the reproductive cells render no services at all to the somatic cells. If we look for the *mutual* dependence we look in vain. We find entire dependence on the one side and none on the other. Between the parts devoted to individual life and the part devoted to species-life, there is no division of labor whatever. The individual works for the species; but the species works not for the individual. Whether at the stage when the species is represented by reproductive cells, or at the stage when it is represented by eggs, or at the stage when it is represented by young, the parent does everything for it, and it does nothing for the parent. The essential part of the conception is gone: there is no giving and receiving, no exchange, no mutuality.

But now suppose we pass over this fallacious interpretation, and grant Prof. Weismann his fundamental assumption and his fundamental corollary. Suppose we grant that because the primary division of labor is that between somatic cells and reproductive cells, these two groups are the first to be differentiated. Having granted this corollary, let us compare it with the facts. As the alleged primary division of labor is universal, so the alleged primary differentiation should be universal too. Let us see whether it is so. Already, in the paragraph from which I

have quoted above, a crack in the doctrine is admitted: it is said that "this differentiation was not at first absolute, and indeed it is not always so to-day." And then, on turning to page 74, we find that the crack has become a chasm. Of the reproductive cells it is stated that—"In Vertebrata they do not become distinct from the other cells of the body until the embryo is completely formed." That is to say, in this large and most important division of the animal kingdom, the implied universal law does not hold. Much more than this is confessed. Lower down the page we read —"There may be in fact cases in which such separation does not take place until after the animal is completely formed, and others, as I believe that I have shown, in which it first arises one or more generations later, viz., in the buds produced by the parent."

So that in other great divisions of the animal kingdom the alleged law is broken; as among the *Cœlenterata* by the Hydrozoa, as among the *Mollusca* by the Ascidians, and as among the *Annuloida* by the Trematode worms.

Even in ordinary life, a man whose supposition proves to be flatly contradicted by observation, is expected to hesitate; though, unhappily, he very often does not. But in the world of science, one who finds his hypothesis at variance with large parts of the evidence, forthwith abandons it. Not so Prof. Weismann. If he does not say with the speculative Frenchman, "*tant pis pour les faits*," he practically says something equivalent:—Propound your hypothesis; compare it with the facts; and if the facts do not agree with it, then assume potential fulfillment where you see no actual fulfillment. For this is what he does. Following his admission above quoted, concerning the Vertebrata, come certain sentences which I partially italicize:

> "Thus, as their development shows, a marked antithesis exists between the substance of the undying reproductive cells and that of the perishable body-cells. We can not explain this fact except *by the supposition* that each reproductive cell potentially contains two kinds of substance, which at a variable time after the commencement of embryonic development, separate from one another, and finally produce two sharply contrasted groups of cells" (p. 74).

And a little lower down the page we meet with the lines:

> "*It is therefore quite conceivable* that the reproductive cells might separate from the somatic cells much later than in the examples mentioned above, without changing the hereditary tendencies of which they are the bearers."

That is to say, it is "quite conceivable" that after sexless *Cercariœ* have gone on multiplying by internal gemmation for generations, the "two kinds of substance" have, notwithstanding innumerable cell-divisions, preserved their respective natures, and finally separate in such ways as to produce reproductive cells. Here Prof. Weismann does not, as in a case before noted, assume

something which it is "easy to imagine," but he assumes something which it is difficult to imagine; and apparently thinks that a scientific conclusion may be thereupon safely based.

But now to what end are we asked to make a gratuitous "supposition," to accept as true something strange which is "quite conceivable," and to strain our imaginations without the slightest aid from the evidence? Simply to save Prof. Weismann's hypothesis—to shelter it against a great body of adverse facts. When we have recognized the truth that what he regards as a primary division of labor is no division of labor at all—when we see that the corollary he draws respecting the implied primary differentiation of reproductive cells from somatic cells is consequently without warrant; we have no occasion to feel troubled that his deductive conclusion is inductively disproved. We are not dismayed on finding that throughout vast groups of organisms there is shown no such antithesis as his theory requires. And we need not do violence to our thoughts in explaining away the contradictions.

Associated with the assertion that the primary division of labor is between the somatic cells and the reproductive cells, and associated with the corollary that the primary differentiation is that which arises between them, there goes another corollary. It is alleged that there exists a fundamental distinction of nature between these two classes of cells. They are described as respectively mortal and immortal, in the sense that those of the one class are limited in their powers of multiplication, while those of the other class are unlimited. And it is contended that this is due to inherent unlikeness of nature.

Before inquiring into the truth of this proposition, I may fitly remark upon a preliminary proposition set down by Prof. Weismann. Referring to the hypothesis that death depends "upon causes which lie in the nature of life itself," he says:

> "I do not however believe in the validity of this explanation; I consider that death is not a primary necessity, but that it has been secondarily acquired as an adaptation. I believe that life is endowed with a fixed duration, not because it is contrary to its nature to be unlimited, but because the unlimited existence of individuals would be a luxury without any corresponding advantage" (p. 24).

This last sentence has a teleological sound which would be appropriate did it come from a theologian, but which seems strange as coming from a man of science. Assuming, however, that the implication was not intended, I go on to remark that Prof. Weismann has apparently overlooked a universal law of evolution—not organic only, but inorganic and superorganic—which implies the necessity of death. The changes of every aggre-

gate, no matter of what kind, inevitably end in a state of equilibrium. Suns and planets die, as well as organisms. The process of integration, which constitutes the fundamental trait of all evolution, continues until it has brought about a state which negatives further alterations, molar or molecular—a state of balance among the forces of the aggregate and the forces which oppose them.* In so far, therefore, as Prof. Weismann's conclusions imply the non-necessity of death, they can not be sustained.

But now let us consider the above-described antithesis between the immortal *Protozoa* and the mortal *Metazoa*. An essential part of the theory is that the *Protozoa* can go on dividing and subdividing without limit, so long as the fit external conditions are maintained. But what is the evidence for this? Even by Prof. Weismann's own admission there is no proof. On page 285 he says:

> "I could only consent to adopt the hypothesis of rejuvenescence [achieved by conjugation] if it were rendered absolutely certain that reproduction by division could never under any circumstances persist indefinitely. But this can not be proved with any greater certainty than the converse proposition, and hence, as far as direct proof is concerned, the facts are equally uncertain on both sides."

But this is an admission which seems to be entirely ignored when there is alleged the contrast between the immortal *Protozoa* and the mortal *Metazoa*. Following Prof. Weismann's method, it would be "easy to imagine" that occasional conjugation is in all cases essential; and this easily imagined conclusion might fitly be used to bar out his own. Indeed, considering how commonly conjugation is observed, it may be held difficult to imagine that it can in any cases be dispensed with. Apart from imaginations of either kind, however, here is an acknowledgment that the immortality of *Protozoa* is not proved; that the allegation has no better basis than the failure to observe cessation of fission; and that thus one term of the above antithesis is not a fact, it is only an assumption.

But now what about the other term of the antithesis—the alleged inherent mortality of the somatic cells? This we shall, I think, find is no more defensible than the other. Such plausibility as it possesses disappears when, instead of contemplating the vast assemblage of familiar cases which animals present, we contemplate certain less familiar and unfamiliar cases. By these we are shown that the usual ending of multiplication among somatic cells is due not to an intrinsic cause, but to extrinsic causes. Let us, however, first look at Prof. Weismann's own statements:

> "I have endeavored to explain death as the result of restriction in the powers of reproduction possessed by the somatic cells, and I have suggested that such

* See First Principles, part ii, chap. xxii, Equilibration.

restriction may conceivably follow from a limitation in the number of cell-generations possible for the cells of each organ and tissue" (p. 28).

"The above-mentioned considerations show us that the degree of reproductive activity present in the tissues is regulated by internal causes while the natural death of an organism is the termination—the hereditary limitation—of the process of cell-division, which began in the segmentation of the ovum" (p. 30).

Now though in the above extracts there is mention of "internal causes" determining "the degree of reproductive activity" of tissue cells, and though, on page 28, the "causes of the loss" of the power of unlimited cell-production "must be sought outside the organism, that is to say, in the external conditions of life"; yet the doctrine is that somatic cells have become constitutionally unfitted for continued cell-multiplication.

"The somatic cells have lost this power to a gradually increasing extent, so that at length they became restricted to a fixed, though perhaps very large, number of cell-generations" (p. 28).

Examination will soon disclose good reasons for denying this inherent restriction. We will look at the various causes which affect their multiplication and usually put a stop to increase after a certain point is reached.

There is first the amount of vital capital given by the parent; partly in the shape of a more or less developed structure, and partly in the shape of bequeathed nutriment. Where this vital capital is small, and the young creature, forthwith obliged to carry on physiological business for itself, has to expend effort in obtaining materials for daily consumption as well as for growth, a rigid restraint is put on that cell-multiplication required for a large size. Clearly the young elephant, starting with a big and well-organized body, and supplied *gratis* with milk during early stages of growth, can begin physiological business on his own account on a great scale; and by its large transactions his system is enabled to supply nutriment to its multiplying somatic cells until they have formed a vast aggregate—an aggregate such as it is impossible for a young mouse to reach, obliged as it is to begin physiological business in a small way. Then there is the character of the food in respect of its digestibility and its nutritiveness. Here, that which the creature takes in requires much grinding-up, or, when duly prepared, contains but a small amount of available matter in comparison with the matter that has to be thrown away; while there, the prey seized is almost pure nutriment, and requires but little trituration. Hence, in some cases, an unprofitable physiological business, and in other cases a profitable one; resulting in small or large supplies to the multiplying somatic cells. Further, there has to be noted the grade of visceral development, which, if low, yields only crude nutriment slowly distributed, but which, if high, serves by its good appli-

ances for solution, depuration, absorption, and circulation, to yield to the multiplying somatic cells a rich and pure blood. Then we come to an all-important factor, the cost of securing food. Here large expenditure of energy in locomotion is necessitated, and there but little—here great efforts for small portions of food, and there small efforts for great portions: again resulting in physiological poverty or physiological wealth. Next, beyond the cost of nervo-muscular activities in foraging, there is the cost of maintaining bodily heat. So much heat implies so much consumed nutriment, and the loss by radiation or conduction, which has perpetually to be made good, varies according to many circumstances—climate, medium (as air or water), covering, size of body (small cooling relatively faster than large); and in proportion to the cost of maintaining heat is the abstraction from the supplies for cell-formation. Finally, there are three all-important co-operative factors, or rather laws of factors, the effects of which vary with the size of the animal. The first is that, while the mass of the body varies as the cubes of its dimensions (*proportions* being supposed constant), the absorbing surface varies as the squares of its dimensions; whence it results that, other things equal, increase of size implies relative decrease of nutrition, and therefore increased obstacles to cell-multiplication.* The second is a further sequence from these laws—namely, that while the weight of the body increases as the cubes of the dimensions, the sectional areas of its muscles and bones increase as their squares; whence follows a decreasing power of resisting strains, and a relative weakness of structure. This is implied in the ability of a small animal to leap many times its own length, while a great animal, like the elephant, can not leap at all: its bones and muscles being unable to bear the stress which would be required to propel its body through the air. What increasing cost of keeping together the bodily fabric is thus entailed, we can not say; but that there is an increasing cost, which diminishes the available materials for increase of size, in beyond question.† And then, in the third place, we have augmented expense of distribution of nutriment. The greater the size becomes, the more force must be exerted to send blood to the periphery; and this once more entails deduction from the cell-forming matters.

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* Principles of Biology, § 46 (No. 8, April, 1863).

† Ibid. This must not be understood as implying that while the mass increases as the cubes, the *quantity of motion* which can be generated increases only as the squares; for this would not be true. The quantity of motion is obviously measured, not by the sectioned areas of the muscles alone, but by these multiplied into their lengths, and therefore increases as the cubes. But this admission leaves untouched the conclusion that the ability to *bear stress* increases only as the squares, and thus limits the ability to generate motion, by relative incoherence of materials.

Here, then, we have nine factors, several of them involving subdivisions, which co-operate in aiding or restraining cell-multiplication. They occur in endlessly varied proportions and combinations; so that every species differs more or less from every other in respect of their effects. But in all of them the co-operation is such as eventually arrests that multiplication of cells which causes further growth; continues thereafter to entail slow decrease in cell-multiplication, accompanying decline of vital activities; and eventually brings cell-multiplication to an end. Now a recognized principle of reasoning—the Law of Parsimony—forbids the assumption of more causes than are needful for explanation of phenomena; and since, in all such living aggregates as those above supposed, the causes named inevitably bring about arrest of cell-multiplication, it is illegitimate to ascribe this arrest to some inherent property in the cells. Inadequacy of the other causes must be shown before an inherent property can be rightly assumed.

For this conclusion we find ample justification when we contemplate types of animals which lead lives that do not put such decided restraints on cell-multiplication. First let us take an instance of the extent to which (irrespective of the natures of cells as reproductive or somatic) cell-multiplication may go where the conditions render nutrition easy and reduce expenditure to a minimum. I refer to the case of the *Aphides*. Though it is early in the season (March), the hothouses at Kew have furnished a sufficient number of these to show that twelve of them weigh a grain—a larger number than would be required were they full-sized. Citing Prof. Owen, who adopts the calculations of Tougard to the effect that by agamic multiplication "a single impregnated ovum of *Aphis* may give rise, without fecundation, to a quintillion of *Aphides*," Prof. Huxley says:

"I will assume that an Aphis weighs $\frac{1}{1000}$ of a grain, which is certainly vastly under the mark. A quintillion of *Aphides* will, on this estimate, weigh a quatrillion of grains. He is a very stout man who weighs two million grains; consequently the tenth brood alone, if all its members survive the perils to which they are exposed, contains more substance than 500,000,000 stout men—to say the least, more than the whole population of China!" *

And had Prof. Huxley taken the actual weight, one twelfth of a grain, the quintillion of *Aphides* would evidently far outweigh the whole human population of the globe: five billions of tons being the weight as brought out by my own calculation! Of course I do not cite this in proof of the extent to which multipli-

* The Transactions of the Linnæan Society of London, vol. xxii, p. 215. The estimate of Réaumur, cited by Kirby and Spence, is still higher—"In five generations one Aphis may be the progenitor of 5,904,900,000 descendants; and it is supposed that in one year there may be twenty generations" (Introduction to Entomology, vol. i, p. 175).

cation of somatic cells, descending from a single ovum, may go; because it will be contended, with some reason, that each of the sexless *Aphides*, viviparously produced, arose by fission of a cell which had descended from the original reproductive cell. I cite it merely to show that when the cell-products of a fertilized ovum are perpetually divided and subdivided into small groups distributed over an unlimited nutritive area, so that they can get materials for growth at no cost, and expend nothing appreciable in motion or maintenance of temperature, cell-production may go on without limit. For the agamic multiplication of *Aphides* has been shown to continue for four years, and to all appearance would be ceaseless were the temperature and supply of food continued without break. But now let us pass to analogous illustrations of cause and consequence open to no criticism of the kind just indicated. They are furnished by various kinds of *Entozoa*, of which take the *Trematoda* infesting mollusks and fishes. Of one of them we read: "*Gyrodactylus* multiplies agamically by the development of a young Trematode within the body, as a sort of internal bud. A second generation appears within the first, and even a third within the second, before the young *Gyrodactylus* is born."* And the drawings of Steenstrup, in his Alternation of Generations, show us, among creatures of this group, a sexless individual, the whole interior of which is transformed into smaller sexless individuals, which severally, before or after their emergence, undergo similar transformations—a multiplication of somatic cells without any sign of reproductive cells. Under what circumstances do such modes of agamic multiplication, variously modified among parasites, occur? They occur where there is no expenditure whatever in motion or maintenance of temperature, and where nutriment surrounds the body on all sides. Other instances are furnished by groups in which, though the nutrition is not abundant, the cost of living is almost unappreciable. Among the *Cœlenterata* there are the Hydroid Polyps, simple and compound; and among the *Mollusca* we have various types of Ascidians, fixed and floating, *Botryllidæ* and *Salpæ*.

But now from these low animals, in which sexless reproduction, and continued multiplication of somatic cells, is common, and one class of which is named "zoöphytes," because its form of life simulates that of plants, let us pass to plants themselves. In these there is no expenditure in effort, there is no expenditure in maintaining temperature, and the food, some of it supplied by the earth, is the rest of it supplied by a medium which everywhere bathes the outer surface: the utilization of its contained material being effected *gratis* by the sun's rays. Just as was to be ex-

* A Manual of the Anatomy of Invertebrated Animals, by T. H. Huxley, p. 206.

pected, we here find that agamogenesis may go on without end. Numerous plants and trees are propagated to an unlimited extent by cuttings and buds; and we have sundry plants which can not be otherwise propagated. The most familiar are the double roses of our gardens: these do not seed, and yet have been distributed everywhere by grafts and buds. Hothouses furnish many cases, as I learn from an authority second to none. Of "the whole host of tropical orchids, for instance, not one per cent has ever seeded, and some have been a century under cultivation." Again, we have the *Acorus calamus*, "that has hardly been known to seed anywhere, though it is found wild all over the north temperate hemisphere." And then there is the conspicuous and conclusive case of *Eloidea Canadensis* (alias *Anacharis*) introduced no one knows how (probably with timber), and first observed in 1847, in several places; and which, having since spread over nearly all England, now everywhere infests ponds, canals, and small slow rivers. The plant is diœcious, and only the female exists here. Beyond all question, therefore, this vast progeny of the first slip or fragment introduced, now sufficient to cover many square miles were it put together, is constituted entirely of somatic cells; and this cell-multiplication, and consequent plant-growth, show no signs of decrease. Hence, as far as we can judge, these somatic cells are immortal in the sense given to the word by Prof. Weismann; and the evidence that they are so is immeasurably stronger than the evidence which leads him to assert immortality for the fissiparously-multiplying *Protozoa*. This endless multiplication of somatic cells has been going on under the eyes of numerous observers for forty odd years. What observer has watched for forty years to see whether the fissiparous multiplication of *Protozoa* does not cease? What observer has watched for one year, or one month, or one week?

Even were not Prof. Weismann's theory disposed of by this evidence, it might be disposed of by a critical examination of his own evidence, using his own tests. Clearly, if we are to measure relative mortalities, we must assume the conditions the same and must use the same measure. Let us do this with some appropriate animal—say Man, as the most open to observation. The mortality of the somatic cells constituting the mass of the human body is, according to Prof. Weismann, shown by the decline and final cessation of cell-multiplication in its various organs. Suppose we apply this test to all the organs: not to those only in which there continually arise bile-cells, epithelium-cells, etc., but to those also in which there arise reproductive cells. What do we find? That the multiplication of these last comes to an end long before the multiplication of the first. In a healthy woman, the cells which constitute the various active tissues of the body continue to grow

and multiply for many years after germ-cells have died out. If similarly measured, then, these cells of the last class prove to be more mortal than those of the first. But Prof. Weismann uses a different measure for the two classes of cells. Passing over the illegitimacy of this proceeding, let us accept his other mode of measurement, and see what comes of it. As described by him, absence of death among the *Protozoa* is implied by that unceasing division and subdivision of which they are said to be capable. Fission continued without end, is the definition of the immortality he speaks of. Apply this conception to the reproductive cells in a *Metazoon*. That the immense majority of them do not multiply without end we have already seen: with very rare exceptions they die and disappear without result, and they cease their multiplication while the body as a whole still lives. But what of those extremely exceptional ones which, as being actually instrumental to the maintenance of the species, are alone contemplated by Prof. Weismann? Do these continue their fissiparous multiplications without end? By no means. The condition under which alone they preserve a qualified form of existence, is that, instead of one becoming two, two become one. A member of series A and a member of series B coalesce, and so lose their individualities. Now, obviously, if the immortality of a series is shown if its members divide and subdivide perpetually, then the opposite of immortality is shown when, instead of division, there is union. Each series ends, and there is initiated a new series, differing more or less from both. Thus the assertion that the reproductive cells are immortal, can be defended only by changing the conception of immortality otherwise implied.

Even apart from these last criticisms, however, we have clear disproof of the alleged inherent difference between the two classes of cells. Among animals the multiplication of somatic cells is brought to an end by sundry restraining conditions; but in various plants, where these restraining conditions are absent, the multiplication is unlimited. It may, indeed, be said that the alleged distinction should be reversed; since the fissiparous multiplication of reproductive cells is necessarily interrupted from time to time by coalescence, while that of the somatic cells may go on for a century without being interrupted.

In the essay to which this is a postscript, conclusions were drawn from the remarkable case of the horse and quagga there narrated, along with an analogous case observed among pigs. These conclusions have since been confirmed. I am much indebted to a distinguished correspondent who has drawn my attention to verifying facts furnished by the offspring of whites and negroes in the United States. Referring to information given him many

years ago, he says: "It was to the effect that the children of white women by a white father had been *repeatedly* observed to show traces of black blood, in cases when the woman had previous connection with [i. e., a child by] a negro." At the time I received this information, an American was visiting me; and, on being appealed to, answered that in the United States there was an established belief to this effect. Not wishing, however, to depend upon hearsay, I at once wrote to America to make inquiries. Prof. Cope, of Philadelphia, has written to friends in the South, but has not yet sent me the results. Prof. Marsh, the distinguished paleontologist, of Yale, New Haven, who is also collecting evidence, sends a preliminary letter in which he says: "I do not myself know of such a case, but have heard many statements that make their existence probable. One instance, in Connecticut, is vouched for so strongly by an acquaintance of mine, that I have good reason to believe it to be authentic."

That cases of the kind should not be frequently seen in the North, especially nowadays, is of course to be expected. The first of the above quotations refers to facts observed in the South during slavery days; and even then, the implied conditions were naturally very infrequent. Dr. W. J. Youmans, of New York, has, on my behalf, interviewed several medical professors, who, though they have not themselves met with instances, say that the alleged result, described above, "is generally accepted as a fact." But he gives me what I think must be regarded as authoritative testimony. It is a quotation from the standard work of Prof. Austin Flint, and runs as follows:

> "A peculiar and, it seems to be, an inexplicable fact is, that previous pregnancies have an influence upon offspring. This is well known to breeders of animals. If pure-blooded mares or bitches have been once covered by an inferior male, in subsequent fecundations the young are likely to partake of the character of the first male, even if they be afterward bred with males of unimpeachable pedigree. What the mechanism of the influence of the first conception is, it is impossible to say; but the fact is incontestable. The same influence is observed in the human subject. A woman may have, by a second husband, children who resemble a former husband, and this is particularly well marked in certain instances by the color of the hair and eyes. A white woman who has had children by a negro may subsequently bear children to a white man, these children presenting some of the unmistakable peculiarities of the negro race." *

Dr. Youmans called on Prof. Flint, who remembered "investigating the subject at the time his larger work was written [the above is from an abridgment], and said that he had never heard the statement questioned."

Some days before I received this letter and its contained quo-

* A Text-Book of Human Physiology. By Austin Flint, M. D., LL. D. Fourth edition. New York: D. Appleton & Co., 1888, p. 797.

tation, the remembrance of a remark I heard many years ago concerning dogs, led to the inquiry whether they furnished analogous evidence. It occurred to me that a friend who is frequently appointed judge of animals at agricultural shows, Mr. Fookes, of Fairfield, Pewsey, Wiltshire, might know something about the matter. A letter to him brought various confirmatory statements. From one "who had bred dogs for many years" he learned that—

"It is a well-known and admitted fact that if a bitch has two litters by two different dogs, the character of the first father is sure to be perpetuated in any litters she may afterward have, no matter how pure-bred a dog may be the begetter."

After citing this testimony, Mr. Fookes goes on to give illustrations known to himself.

"A friend of mine near this had a very valuable Dachshund bitch, which most unfortunately had a litter by a stray sheep-dog. The next year her owner sent her on a visit to a pure Dachshund dog, but the produce took quite as much of the first father as the second, and the next year he sent her to another Dachshund with the same result. Another case: A friend of mine in Devizes had a litter of puppies, unsought for, by a setter from a favorite pointer bitch, and after this she never bred any true pointers, no matter of what the paternity was."

These further evidences, to which Mr. Fookes has since added others, render the general conclusion incontestable. Coming from remote places, from those who have no theory to support, and who are some of them astonished by the unexpected phenomena, the agreement dissipates all doubt. In four kinds of mammals, widely divergent in their natures—man, horse, dog, and pig—we have this same seemingly anomalous kind of heredity made visible under analogous conditions. We must take it as a demonstrated fact that, during gestation, traits of constitution inherited from the father produce effects upon the constitution of the mother; and that these communicated effects are transmitted by her to subsequent offspring. We are supplied with an absolute disproof of Prof. Weismann's doctrine that the reproductive cells are independent of, and uninfluenced by, the somatic cells; and there disappears absolutely the alleged obstacle to the transmission of acquired characters.

Notwithstanding experiences showing the futility of controversy for the establishment of truth, I am tempted here to answer opponents at some length. But even could the editor allow me the needful space, I should be compelled both by lack of time and by ill health to be brief. I must content myself with noticing a few points which most nearly concern me.

Referring to my argument respecting tactual discriminativeness, Mr. Wallace thinks that I—

"afford a glaring example of taking the unessential in place of the essential, and drawing conclusions from a partial and altogether insufficient survey of the phenomena. For this 'tactual discriminativeness,' which is alone dealt with by Mr. Spencer, forms the least important, and probably only an incidental portion of the great vital phenomenon of skin-sensitiveness, which is at once the watchman and the shield of the organism against imminent external dangers" (Fortnightly Review, April, 1893, p. 497).

Here Mr. Wallace assumes it to be self-evident that skin-sensitiveness is due to natural selection, and assumes that this must be admitted by me. He supposes it is only the unequal distribution of skin-discriminativeness which I contend is not thus accounted for. But I deny that either the general sensitiveness or the special sensitiveness results from natural selection; and I have years ago justified the first disbelief, as I have recently the second. In The Factors of Organic Evolution, pp. 66–70, I have given various reasons for inferring that the genesis of the nervous system can not be due to survival of the fittest; but that it is due to the direct effects of converse between the surface and the environment; and that thus only is to be explained the strange fact that the nervous centers are originally superficial, and migrate inward during development. These conclusions I have, in the essay Mr. Wallace criticises, upheld by the evidence which blind boys and skilled compositors furnish; proving, as this does, that increased nervous development is peripherally initiated. Mr. Wallace's belief that skin-sensitiveness arose by natural selection is unsupported by a single fact. He assumes that it *must* have been so produced because it is all-important to self-preservation. My belief that it is directly initiated by converse with the environment is supported by facts; and I have given proof that the assigned cause is now in operation. Am I called upon to abandon my own supported belief and accept Mr. Wallace's unsupported belief? I think not.

Referring to my argument concerning blind cave animals, Prof. Lankester, in Nature of February 3, 1893, writes:

"Mr. Spencer shows that the saving of ponderable material in the suppression of an eye is but a small economy: he loses sight of the fact, however, that possibly, or even probably, the saving of the organism in the reduction of an eye to a rudimentary state is not to be measured by mere bulk, but by the non-expenditure of special materials and special activities which are concerned in the production of an organ so peculiar and elaborate as is the vertebrate eye."

It seems to me that a supposition is here made to do duty as a fact; and that I might with equal propriety say that "possibly, or even probably," the vertebrate eye is physiologically cheap: its optical part, constituting nearly its whole bulk, consisting of a low order of tissue. There is, indeed, strong reason for considering it physiologically cheap. If any one remembers how relatively enormous are the eyes of a fish just out of the egg—a pair of eyes

with a body and head attached; and if he then remembers that every egg contains material for such a pair of eyes; he will see that eye-material constitutes a very considerable part of the fish's roe; and that, since the female fish provides this quantity every year, it can not be expensive. My argument against Weismann is strengthened rather than weakened by contemplation of these facts.

Prof. Lankester asks my attention to a hypothesis of his own, published in the Encyclopædia Britannica, concerning the production of blind cave-animals. He thinks it can—

"be fully explained by natural selection acting on congenital fortuitous variations. Many animals are thus born with distorted or defective eyes whose parents have not had their eyes submitted to any peculiar conditions. Supposing a number of some species of Arthropod or Fish to be swept into a cavern or to be carried from less to greater depths in the sea, those individuals with perfect eyes would follow the glimmer of light and eventually escape to the outer air or the shallower depths, leaving behind those with imperfect eyes to breed in the dark place. A natural selection would thus be effected" in successive generations.

First of all, I demur to the words "many animals." Under the abnormal conditions of domestication, congenitally defective eyes may be not very uncommon; but their occurrence under natural conditions is, I fancy, extremely rare. Supposing, however, that in a shoal of young fish, there occur some with eyes seriously defective. What will happen? Vision is all-important to the young fish, both for obtaining food and for escaping from enemies. This is implied by the immense development of eyes just referred to. Considering that out of the enormous number of young fish hatched with perfect eyes, not one in a hundred reaches maturity, what chance of surviving would there be for those with imperfect eyes? Inevitably they would be starved or be snapped up. Hence the chances that a matured or partially matured semi-blind fish, or rather two such, male and female, would be swept into a cave and left behind are extremely remote. Still more remote must the chances be in the case of crayfish. Sheltering themselves as these do under stones, in crevices, and in burrows which they make in the banks, and able quickly to anchor themselves to weeds or sticks by their claws, it seems scarcely supposable that any of them could be carried into a cave by a flood. What, then, is the probability that there will be two nearly blind ones, and that these will be thus carried? Then after this first extreme improbability, there comes a second, which we may, I think, rather call an impossibility. How would it be possible for creatures subject to so violent a change of habitat to survive? Surely death would quickly follow the subjection to such utterly unlike conditions and modes of life. The existence

of these blind cave-animals can be accounted for only by supposing that their remote ancestors began making excursions into the cave, and, finding it profitable, extended them, generation after generation, further in: undergoing the required adaptations little by little.

I turn now to Dr. Romanes. He says that I do not understand Weismann; and that the cause of degeneration to which he gives the name of "Panmixia" is not the continued selection of the smaller variations. Let us see what are Weismann's words.

"The complete disappearance of a rudimentary organ can only take place by the operation of natural selection; this principle will lead to its elimination, inasmuch as the disappearing structure takes the place and the nutriment of other useful and important organs" (Essays upon Heredity, p. 88).

"Those fluctuations on either side of the average which we call myopia and hypermetropia, occur in the same manner, and are due to the same causes, as those which operate in producing degeneration in the eyes of cave-dwelling animals" (Ib., p. 89).

Here, then, are two propositions: (1) "Fluctuations on either side of the average" "operate in producing degeneration in the eyes of cave-dwelling animals." (2) "A rudimentary organ" is removed "by the operation of natural selection." Why are "fluctuations on either side of the average" named, unless it is that natural selection takes advantage of them by preserving the smaller variations? If this is not meant the use of the expression is meaningless. Yet Dr. Romanes agrees with Weismann in regarding the "degenerated eye of the *Proteus* as a good example of the disappearance of a complex and useless structure by Panmixia."* So that Panmixia is clearly identified with the selection of the smaller variations; and for the reason that economy of nutrition is so achieved. Where, then, is the misunderstanding? That my interpretation is correct I have further reason for holding; namely, that it is the one given by Weismann's adherent, Prof. Lankester, in Nature, March 27, 1890 (pp. 487, 488). But while I can not admit my failure to understand Weismann, I confess that I do not understand Dr. Romanes. How, when natural selection, direct or reversed, is set aside, the mere cessation of selection should cause decrease of an organ *irrespective of the direct effects of disuse*, I am unable to see. Clearer conceptions of these matters would be reached if, instead of thinking in abstract terms, the physiological processes concerned were brought into the foreground. Beyond the production of changes in the sizes of parts by the selection of fortuitously arising variations, I can see but one other cause for the production of them—the

* Contemporary Review, April, 1893, p. 509.

competition among the parts for nutriment. This has the effect that active parts are well supplied and grow, while inactive parts are ill supplied and dwindle.* This competition is the cause of "economy of growth"; this is the cause of decrease from disuse; and this is the only conceivable cause of that decrease which Dr. Romanes contends follows the cessation of selection. The three things are aspects of the same thing. And now, before leaving this question, let me remark on the strange proposition which has to be defended by those who deny the dwindling of organs from disuse. Their proposition amounts to this:—that for a hundred generations an inactive organ may be partially denuded of blood all through life, and yet in the hundredth generation will be produced of just the same size as in the first!

There is one other passage in Dr. Romanes' criticism—that concerning the influence of a previous sire on progeny—which calls for comment. He sets down what he supposes Weismann will say in response to my argument. "First, he may question the fact." Well, after the additional evidence given above, I think he is not likely to do that; unless, indeed, it be that along with readiness to base conclusions on things "it is easy to imagine" there goes reluctance to accept testimony which it is difficult to doubt. Second, he is supposed to reply that "the germ-plasm of the first sire has in some way or another become partly commingled with that of the immature ova"; and Dr. Romanes goes on to describe how there may be millions of spermatozoa and "thousands of millions" of their contained "ids" around the ovaries, to which these secondary effects are due. But, on the one hand, he does not explain why in such case each subsequent ovum, as it becomes matured, is not fertilized by the sperm-cells present, or their contained germ-plasm, rendering all subsequent fecundations needless; and, on the other hand, he does not explain why, if this does not happen, the potency of this remaining germ-plasm is nevertheless such as to affect not only the next succeeding offspring, but all subsequent offspring. The irreconcilability of these two implications would, I think, sufficiently dispose of the supposition, even had we not daily multitudinous proofs that the surface of a mammalian ovarium is not a spermatheca. The third difficulty Dr. Romanes urges is the inconceivability of the process by which the germ-plasm of a preceding male parent affects the constitution of the female and her subsequent offspring. In response, I have to ask why he piles up a mountain of difficulties based on the assumption that Mr. Darwin's explanation of heredity by "Pangenesis" is the only available explana-

* See Social Organism in Westminster Review for January, 1860; also Principles of Sociology, § 247.

tion preceding that of Weismann? and why he presents these difficulties to me more especially, deliberately ignoring my own hypothesis of physiological units? It can not be that he is ignorant of this hypothesis, since the work in which it is variously set forth (Principles of Biology, §§ 66–97) is one with which he is well acquainted: witness his Scientific Evidences of Organic Evolution; and he has had recent reminders of it in Weismann's Germ-plasm, where it is repeatedly referred to. Why, then, does he assume that I abandon my own hypothesis and adopt that of Darwin, thereby entangling myself in difficulties which my own hypothesis avoids? If, as I have argued, the germ-plasm consists of substantially similar units (having only those minute differences expressive of individual and ancestral differences of structure), none of the complicated requirements which Dr. Romanes emphasizes exist, and the alleged inconceivability disappears.

Here I must end: not intending to say more, unless for some very urgent reason, and leaving others to carry on the discussion. I have, indeed, been led to suspend for a short time my proper work only by consciousness of the transcendent importance of the question at issue. As I have before contended, a right answer to the question whether acquired characters are or are not inherited, underlies right beliefs not only in Biology and Psychology, but also in Education, Ethics, and Politics.—*Contemporary Review.*

## THE COLOR CHANGES OF FROGS.

By Prof. CLARENCE M. WEED.

ONE who, with observant eye, leisurely paddles among the water lilies of an inland lake must often notice how closely the colors of the various frogs resting upon or among the lily pads resemble their environment. In the open sunshine, where light green is the prevailing tint, the colors of the frogs closely approximate it, but in the dark and shady recesses of the forest-bordered banks the batrachians are dull, deep brown, with darker spots scattered over their bodies. These are the effects as seen from above. If one were to dive beneath the water and look upward, he would see in either case only the whitish undersides of their bodies and legs—if, indeed, these were visible against the general lightness of the upper world.

It is evident that this resemblance to environment might result in either of two ways: first, the light-colored frogs might seek the light surroundings and the dark ones the dark surroundings; or, second, the frogs, provided they had the power, might

change their color to agree with the environment. The latter method would, of course, from the frog's point of view, be decidedly the more desirable, saving him much exertion in seeking safe retreats; and recent researches have shown that this is in fact the method adopted.

The ability of the tree frogs, or "tree toads" (*Hylidæ*), to change their color has long been known, but precise studies of the color changes of the common ground frogs (*Ranidæ*) have only been made comparatively recently, and as yet the record is far from complete. A few years ago Dr. Fickert, of Tübingen, experimented with the color adaptability of the common European frog (*Rana temporaria*): "Three frogs approximately similar in color were placed in three glass vessels, of which the first stood on a black, the second on a green, and the

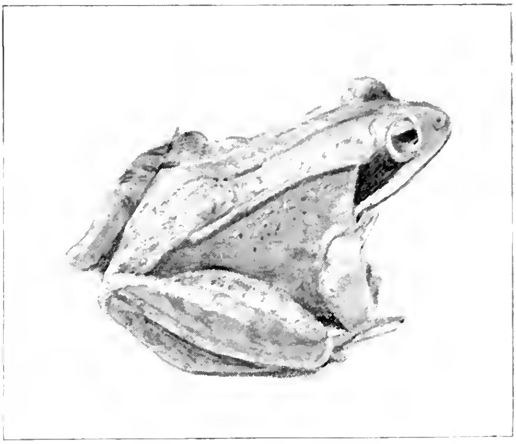


Fig. 1.—Wood Frog. Adult.

third on a white surface, being surrounded up to a height of some five centimetres with the same color. After about an hour and a half the frog *a* on the black surface was the darkest, *b* on the white the lightest, while the frog *c* surrounded by green was intermediate in color between the two. Hereupon the frog *a* was transferred to the glass on the white, frog *b* into the one on the black surface. After three quarters of an hour they were again examined, and *a* was the lightest, *b* the darkest. Then *c* and *b* were interchanged, and in a quarter of an hour *c* was the darkest, while *b* was intermediate in color between *c* and *a*. When, finally, *b* and *a* were interchanged, a change of coloring appeared immediately; *b* became light again, and *a* took the intermediate tint between *b* and *c*." *

A similar but less complete experiment with the same species of frog was made many years previously by Sir Joseph Lister, who found that "a frog caught in a recess in a black rock was itself almost black, but after it had been kept for about an hour on white flagstones in the sun was found to be dusky yellow, with dark spots here and there. It was then placed again in the hol-

* Eimer, Organic Evolution, Cunningham's translation, p. 118.

low of the rock, and in a quarter of an hour had resumed its former darkness." *

I have recently made a number of observations upon the commoner New England frogs which show that our species possess the power of color adaptation to a large extent. The prettiest of our frogs is the common wood frog (*Rana sylvatica*), a pale, reddish-brown species, nearly an inch and a half long when adult (Fig. 1), but very often found in the smaller immature condition (Fig. 2). It is most commonly seen on the carpets of pine needles in the woods, where its color is precisely like that of the bed of needles on which it lives. When found in fields and meadows away from the woods it is seldom reddish brown, being usually either light fawn color or dark brown.

A fine large wood frog was brought to my laboratory August 8th, and placed in a glass vivarium near a window. I began to study its color changes August 11th, at noon, adopting as a color standard the plates in Ridgway's admirable Nomenclature of Colors,† and the figures in parentheses hereafter refer to those plates. At the time mentioned the frog was light fawn color (III, 22) on the back. That night it escaped from the vivarium and wandered about the laboratory, being found the next day at 1 P. M. It was then much darker than before, the fawn color having changed to Van Dyke brown (III, 5), and the sides being dark clove brown (III, 2). Mr. Sylvatica was next placed in a dry glass jar, and put in a corner of the room with a white wall on two sides of it. Three days later (August 15th, 11 A. M.) it was an extremely light fawn color on the back (III, 22, but lighter), with the sides very light drab, approaching écru drab (III, 21).


Fig. 2. Wood Frog. Immature.

A little water was next placed in the bottom of the jar, and it was put beside a blackboard, where it was left until August 23d. The frog was then cinnamon color (III, 20), with sides dark drab. I then placed it in an open window on a whitish bottom, and the next day it was light brown. At 2 P. M., August 24th, I put it on a jet-black shelf, with black surroundings. Forty-five minutes later it was very dark, nearly mummy brown (III, 10), but darker. At

* Poulton, Colors of Animals, p. 83.

† A Nomenclature of Colors for Naturalists, by Robert Ridgway, Boston, 1886.

3 P. M., while it was still so dark, I put it back in the window with white surroundings; at 3.05 it was considerably lighter brown, at 3.10 much lighter, and at 3.15 it had become cinnamon-colored —a very marked change thus occurring in fifteen minutes.

These experiments were repeated a number of times with several different individuals, and similar results were obtained.

The common green frog (*Rana clamata*) has the power of changing its color to a considerable extent. Specimens kept for some time amid light surroundings became of a very light green color—even lighter than apple green—while if placed amid a black environment they become very dark. The leopard frog, or spotted frog (*R. virescens*), is not able to change its appearance so completely, the permanent color markings preventing; but the green ground color varies somewhat. The few observations I have been able to make on the bullfrog (*R. catesbiana*) indicate that its ability in this direction is very similar to that of the green frog.

The power of color change is also present to a decided extent in our common toad (*Bufo lentiginosus*). A very large specimen of this species was found in wet grass June 1st, at 11 P. M. It was then of a light wax-yellow color. It was brought to the laboratory and put in a glass jar on a black shelf. Twenty-four hours later it was very much darker, being tawny olive brown. Three days later it had become still darker, being almost clove brown. A similar power has been observed in the European toad.

It is conceivable that these color changes might occur in either of two ways: First, by the direct action of the light reflected from the surroundings upon the pigment cells of the skins, and second, by an indirect action through the eye of the animal. The second method is the one involved. Experiments have shown that, when blinded, a frog does not change its color to agree with the environment. Mr. Poulton describes the process of change by saying that "certain kinds of light act as specific stimuli to the eye of the animal, and differing nervous impulses pass from this organ along the optic nerve to the brain. The brain being thus indirectly stimulated in a peculiar manner by various kinds of reflected light, originates different impulses, which pass from it along the nerves distributed to the skin, and cause varying states of concentration of the pigment in the cells. . . . The pigment cells in the skin are often of various colors, and are arranged in layers, so that very different effects may be produced by concentration in certain cells, leading to the appearance of those of another color, or to a combined effect due to the colors of two or more kinds of cells." *

* *Loc. cit.*, p. 85.

Probably the most important advantage derived by the frogs from their power of color change is that of concealment from birds and other enemies. Many of the larger waders devour these animals whenever opportunity offers, and a protective resemblance would help greatly in escaping detection. In the case of the wood frog, I suspect that the resemblance to the carpet of pine needles helps to preserve them from birds of other kinds—the hawks and owls. Last summer I placed a wood frog in a cage containing a red-tailed hawk (*Buteo borealis*), and it was immediately gobbled up by the bird.

It also seems likely that the resemblance to the environment may be of benefit to the species in enabling it more readily to obtain its insect food, but in the present state of our knowledge of the vision of insects one can not place very much stress upon this phase of the subject.

## WHY A FILM OF OIL CAN CALM THE SEA.

By G. W. LITTLEHALES,

CHIEF OF DIVISION OF CHART CONSTRUCTION, UNITED STATES HYDROGRAPHIC OFFICE.

NEXT to the oil which is used in the beacons of the world to give light to save life, that which is most effective in forestalling the loss of life and the destruction of property is the quantity that is expended by mariners in forming a film around their vessels to subdue the violence of breaking waves. The extensive practice of using oil for this purpose is the outgrowth of an age of quick ocean passages which has impelled seamen to crowd on every foot of canvas and every pound of steam in the attempt to run through storm and calm alike. In any large seaport a visit to the docks where mariners tell the experiences of their voyages will afford evidence of the extent and efficacy of this practice; but, before proceeding to point out the principles involved, it will be of interest to give extracts from the log-books of a few vessels, to show the manner and effect of the use of oil. From the official notes of Captain Tregarthen, of the British steamship Marmanhense, the following extract has been made: "On March 3d, off Cape Hatteras, in a very strong northwest hurricane, finding the ship could make no headway, I hove to. The wind was blowing in hurricane force from the northwest, and the tremendous sea which was running broke on board and did great damage. The vessel was very unsteady, coming up and falling off several points, so that I could not steer her nor keep her head to the sea, although the engines were working well. I filled the water-closet bowls with oakum and poured fish oil over it, keeping men stationed by them to replenish the supply. I also filled a

small canvas bag with oakum, saturated with the same kind of oil, and towed it by a line from the weather bow of the vessel so that it would drift several fathoms to windward. The vessel now rode much more easily and could be kept head to sea. Moreover, no water came on board, and the sea was without breaking crests for thirty yards to windward of her. I feel no hesitancy in stating that, with the proper use of oil, I shall be perfectly willing to encounter the hardest gale that ever blew; and intend at the first opportunity, to stop the engines, place several oil bags to windward, and let the vessel drift as she will. I feel sure that the vessel will be safe under these conditions."

Captain Bower, while on a voyage from New York to the Mediterranean last December in the steamship Ponca, encountered a strong gale with very high seas. He says: "The vessel was deeply laden with grain and became unmanageable. We were running before the seas and shipping large quantities of water, until two small bags filled with colza oil were put over on each side of the bridge. This oil was found to be too light and of little use; but after olive oil was put in the bags no more water was shipped and the decks became almost as dry as in fine weather, although the gale continued for two days. The vessel was drawing twenty-six and a half feet of water, and, if we had not used oil, I do not think she could have withstood the storm."

Captain William Peake, master of the schooner J. F. Krantz, while making a passage from Port Spain, Trinidad, to Boston, met a terrific gale off Cape Hatteras and had the following experience: "The sails were blown away, men washed from the pumps, and boats and other things above the deck wrecked by the heavy seas. I was compelled to head southward and scud under bare poles. Then I thought of oil, and determined to see what effect it would have on the sea. Two wooden, ten-gallon kegs, containing boiled linseed oil, were lashed to the quarters of the vessel. The oil was allowed to ooze out through two small holes in the heads of the kegs. The effect was all that could be desired. After the oil had spread, no water came on board, the men returned to the pumps, the vessel was pumped out, and the decks were cleaned up. During the sixteen hours in which oil was used eight gallons were expended."

An examination of thousands of reports like the preceding ones demonstrates that a small quantity, say two quarts per hour, of the thick and heavy oils, especially those of animal and vegetable origin, when allowed to drop into the sea soon spreads over its surface, forming an oily layer within the area of which the waves, instead of breaking, become huge rollers upon which the vessels rise and fall without shocks and without shipping any water.

So much for the practical effects of oil on broken water. Now let us proceed to examine the reasons why so small a quantity of oil can produce these effects. In order to understand the methods for opposing the violence of waves, it is essential that the phenomena which constitute wave motion be understood. It can be said with some degree of confidence that there is no instance in Nature of a perfectly quiescent surface of water. Air and water are both mediums of extreme mobility, and the individual molecules of both, and of all other substances, are continually in a state of motion, with different velocities, in paths different in direction and length. There is thus a continual interlacing of particles. When air covers water, some of the particles of air, in their excursions, strike the surface of the water, producing unequal pressures upon it, and giving rise to ripples which the vision is not acute enough to detect. If the original surface of the water were perfectly smooth, and if all parts of it continued equally exposed to an equal wind, waves could not be produced. But with the minute corrugations which are always present upon the smoothest water it is to be observed that it does not occur that water is all equally exposed to equal winds. The pressure of moving air upon the crests and posterior portions of the minute corrugations is greater than that on the hollows and anterior portions. There is thus a tendency to heap up the water at the places of greatest pressure, which is augmented by the rotational or vortex motion produced by the viscosity of the air. These actions produce new forms and inequalities, which, exposed to the wind, generate new modifications of its force and give rise to further deviations from the primitive condition of the fluid. Imagine an isolated example in which the water has been suddenly heaped up by a gust of wind. The action of gravity causes the particles of water in the heap to push forward the particles immediately in front of them out of their former place to another place farther on, and they repose in their new place at rest as before the original heaping up. Thus in succession volume after volume continues to carry on a process of displacement which only ends with the exhaustion of the displacing force originally impressed and communicated from one to another successive mass of water. As the particles of water crowd upon one another in the act of going out of their old places into the new, the crowd forms a temporary heap visible on the surface of the water, and as each successive mass is displacing its successor there is always one such heap, and this heap travels apparently at that point where the process of displacement is going on; and although there may be only one crowd, yet it consists of always another and another set of migrating particles. This moving crowd constitutes a true wave. The velocity of the wave is the velocity with which the heap is seen to move. Its form is

the form of the heap. Its length is the distance from crest to crest, and its height is the distance from the crest to the surface of the water before the disturbance.

The motions of the individual particles of water are different from the motion of translation which the wave has. Consider a particle in a mass of water about to be traversed by a wave form. The action of gravity on the heap behind it tends to press it forward, where it is confronted by a solid wall of water. Under the action of these two opposite forces the particle is driven upward and forward until the particles which have displaced it have made room for themselves; then it sinks, and finally comes to rest a little in advance of the place from which it started. The motion of migration of each individual particle is thus in a closed orbit. The propagation of the wave is the advancement of a mere form. The actual translation of water in the propagation of unbroken waves is small. The motion of each particle takes place in a vertical plane parallel to the direction of propagation of the wave. The path of orbit described by each particle is approximately elliptic, and in water of nearly uniform depth the longer axis of the elliptic orbit is horizontal and the shorter vertical. When at the top of its path, the particle moves forward as regards the direction of propagation; when at the bottom, backward, as shown by the curved arrows in Fig. 1. The straight arrow denotes the direction of propagation.

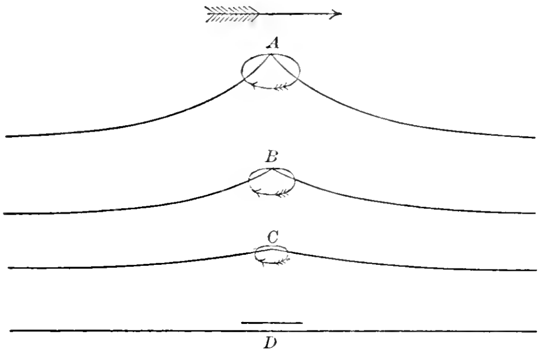


Fig. 1.

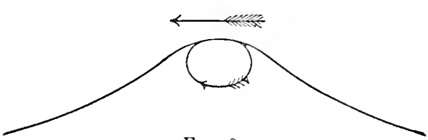


Fig. 2.

The particles at the surface describe the largest orbits. The extent of the motion horizontally and vertically diminishes with the depth below the surface. A particle in contact with the bottom of water of moderate depth moves backward and forward in a horizontal straight line, as at D. On the ocean, where the water is deep as compared with the length of a wave, the paths of the particles are nearly circular, and the motion is insensible at great depths.

When waves are first raised at sea their crests are smooth and rounded, as represented in Fig. 2. As the wind freshens the crests

rise higher and become more acuminate. Rankine has investigated the limiting forms which waves assume before breaking, and has concluded that in the steepest possible oscillatory waves of the irrotational kind, the crests become curved at the vertex in such a manner that a section of the crest by the plane of motion presents two branches of a curve which meet at an angle of ninety degrees.

After the prolonged action of the wind, when the crests of the waves rise to a considerable height and become sharper and sharper, the passage of the air over them with high velocity tends to impart its velocity to them. Owing to the inertia of the lower masses of water, the imparting of this velocity is resisted. The paths of the particles become distorted, as shown in Fig. 3, the front of each wave gradually becomes steeper than the back, and the crests seem to advance faster than the troughs, until at length the front of the wave curls over and breaks, as shown in Fig. 4.

FIG. 3.

Large sea-waves seem to be the result of a building-up process carried on by the joint action of large and small waves. If, for any cause, there be one wave larger than those surrounding it, its size will be continually increased at the expense of the smaller ones. For these smaller waves, in passing over the tops of the larger, offer increased obstruction to the wind and cause the formation of cusps when the waves coincide. The delicate equilibrium incident to a cusped form is easily destroyed by the action of the wind, and the crests of the waves break into fragments which go to increase the volume of large waves, leaving the small ones yet smaller. Therefore, whatever influence prevents the breaking of waves acts also as an agency to prevent their increase in size. No fact of observation and no method of sound reasoning has yet led to the conclusion that the spreading of oil on the surface of water agitated by waves can exercise any sensible effect in lessening the size or velocity of the waves themselves. It is in the breaking of the waves that the oil finds its field of action.

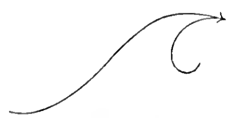


FIG. 4.

Having reviewed the structure of sea waves, the next step is to show why oil spreads over the surface of water. There is an attraction of one particle of water for another, and there is an attraction of one particle of oil for another, but there is a repulsion between a particle of water and a particle of oil. If we attempt to mix oil and water, the two liquids separate from each other of themselves, and in the act of separation sufficient force is brought into play to set in motion considerable masses of the fluids.

Imagine an individual particle of water within a mass of water.

The particles on every side of the individual particle attract it, and the attraction of opposite particles on every side tends to neutralize each other, so that the individual particle has almost perfect mobility. The surface particles, however, inasmuch as all the rest of the fluid is below them, are drawn inward toward the mass of the fluid, and a certain tension is produced. This tension is potential energy, and is inherent in the surface particles in virtue of their position. If we consider an oily film to be spread over the surface of a body of water, it will appear that the particles near the surfaces which separate the oil from the water and from the air must have greater energy than those in the interior of the film. The excess of energy due to this cause will be proportional to the area of the surface of separation. When this area is increased in any way, work must be done; and when it is allowed to contract, it does work upon other bodies. Hence it acts like a stretched sheet of India rubber, and exerts a tension of the same kind.

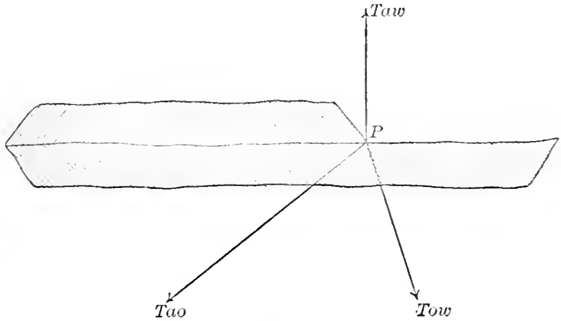



FIG. 5.

In the above figure, which represents an exaggerated picture of a layer of oil on the surface of a body of water, let *Taw* represent the superficial tension of the surface separating air from water; let *Tao* represent the superficial tension of the surface separating air from oil; let *Tow* represent the superficial tension of the surface separating oil from water; and let P be a point of the line forming the common intersection of the surfaces separating the air, oil, and water. For the equilibrium of these three media, the three tensions *Taw*, *Tao*, and *Tow* must be in equilibrium along the line of common intersection, and since these tensions have been measured and are known, the angles which their directions make with one another can be easily determined; for, by constructing a triangle, A B C, having sides proportional to these tensions, the exterior angles will be equal to the angles formed by the three surfaces of separation which meet in a line. But it is not always possible to construct a triangle with three given lines as its sides. If one of the lines is greater in length than the sum of the lengths of the other two, the triangle is impossible. For the same reason, if any one of the superficial

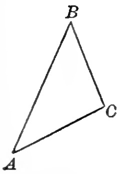



FIG. 6.

tensions is greater than the sum of the other two, the three fluids can not be in equilibrium in contact.

If, therefore, the tension of the surface separating air from water is greater than the sum of the tensions of the surfaces separating air from oil and oil from water, then a drop of oil can not be in equilibrium on the surface of water. The edge of the drop where the air meets the oil and the water becomes thinner and thinner, till it covers a vast expanse of water.

M. Quinke has determined the superficial tensions of different liquids in contact with one another and with air, and the following is an extract from his table of results. The tension is measured in grammes per linear centimetre at twenty degrees centigrade:

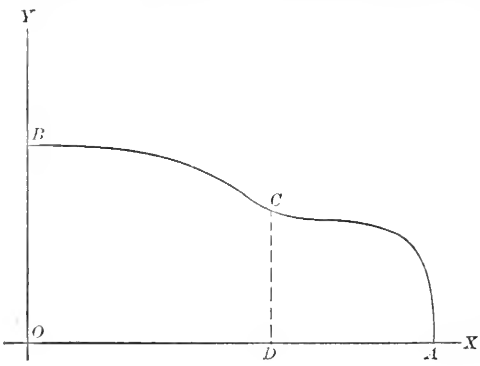
| Liquid. | Specific gravity. | Tension of surface separating liquid from air. | Tension of surface separating liquid from water. |
|---|---|---|---|
| Water | 1·0000 | ·08235 | ·00000 |
| Olive oil | 0·9136 | ·03760 | ·02096 |

Although olive oil is here taken as the representative of oils, it is not considered so well adapted for use at sea as some of the others. Whale oil has given the best results, but its surface tensions do not seem to have been determined. It may be presumed that they do not differ greatly from the values given for olive oil.

An inspection of the above table will show that the tension of the surface separating air from water is greater than the sum of the tensions of the surfaces separating air from oil and oil from water, which explains why a film of oil will spread over the surface of a body of water.

Through the operation of surface tensions much of the force which breakers have is lost. Let us imagine a "break" to occur after the surface of the water is covered by the oily film.* For

* Above it has been assumed that the *superficial tension per unit of length* has the same numerical value as the *superficial energy per unit of area*, which can be proved as follows:




Let the equation to the curve B C A be $y = f(x)$. Take any ordinate, as C D, whose length is $y$, and let the whole tension exerted across the line be represented by $\phi$, then the superficial tension is measured by the tension across a unit length of $y$, or, since $\phi$ is the tension across the whole ordinate $y$, if T, which is constant, is the superficial tension per unit of length, $\phi = Ty = T . f\ (x)$. Suppose that the variable ordinate $y$ is originally in contact with the axis O B, and that the surface included

every square centimetre of film torn asunder there will be destroyed ·05856 centigrammetre of potential energy, being the sum of ·03760 and ·02096, the potential or surface energies, in centigrammetres per square centimetre, of the surfaces separating air from oil and oil from water; and there will be generated for every square centimetre of free surface of water formed, ·08235 centigrammetre of potential energy. The mere fact of breaking the film of oil causes an expenditure of energy, because it lays bare a surface having a tension greater than the sum of the tensions of the surfaces separating air from oil and oil from water. But there is a further loss of energy in these circumstances. Suppose after a "break" has occurred, a layer of water glides over a layer of oil. The superficial energy in the surface separating the oil from the air, amounting to ·03760 centigrammetres per square centimetre, is replaced by ·10331 centigrammetre per square centimetre, being the sum of ·08235 and ·02096, the superficial energies per square centimetre of the surfaces separating air from water and water from oil respectively. Therefore, when water breaks over an oily film, there is required for the formation of each square centimetre of a layer of water on the oily film, ·10331 minus ·03760, or ·06571 centigrammetre of work.

The film of oil also acts as a shield to prevent the derangement of the wave mechanism and to prevent the growth of waves and the formation of sharp crests. It has been pointed out that, when waves are propagated across any body of liquid, the individual particles of the liquid, having their centrifugal and centripetal forces in equilibrium, describe closed orbits. At the highest points of these orbits, or in the crests of the waves, the particles are moving in the direction of propagation of the waves.

When the wind is blowing over the waves with a velocity greater than the velocity of propagation, and in the same direction with it, the moving air tends to impart to the particles of water a velocity additional to the normal velocity of revolution in their orbits, causing the distortion of the orbits and the disintegration of the crests of the waves. The force which the moving air exerts to draw the water along with it is due to the viscosity of air.

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between the curve and the two axes is produced by drawing the ordinate $y$ away from the axis O B toward the right by the action of the force $\phi$. If we consider O B and D C, which is equal to $y$, to be two rods wet with oil and placed between the curve and the axis of X, and then drawn asunder, the oily film B C A D O will be formed. Let E represent the superficial energy per unit of area. Then the work done in forming the film will be $= E\int f(x)\,dx$. But if $\phi$ is the variable force required to draw the ordinate $y$ from the axis O B, the same work may be written $= \int \phi\,dx$. Therefore, work $= \int \phi\,dx = E\int f(x)\,dx$ (1). Substituting the value $\phi = Tf(x)$ in (1), we have $T\int f(x)\,dx = E\int f(x)\,dx$, or T = E, or that the numerical value of the superficial tension per unit of length is equal to the superficial energy per unit of area.

When wind blows over water, all the air does not pass over the surface of the water. On account of the high degree of adhesion between air and water, a thin stratum of air remains in contact with the water, and it is the action of the internal friction or viscosity of air tending to draw this stratum along which causes the tractive effect of wind on water.

When a film of oil is spread over the surface, this tractive force is not brought to bear on the surface of the water as long as the film remains unbroken, but acts upon the surface of the film, whose particles, being entirely separate from the particles of water, do not share their motion. The surface of the water is thus shielded from the action of the wind in the same manner as if a skin of India rubber were spread over it, and the only action of the wind in such a case is to move the film over the surface of the water.

It is calculated that a wind moving at the rate of twenty-five miles per hour or one hundred and twelve centimetres per second, relatively to the surface of the water, exercises a tractive effect of about two thousandths of a gramme upon each square centimetre of surface; and, when we consider that this force is brought to bear upon a system of particles moving in their orbits, in the direction in which the wind blows, with a speed of about eighty centimetres per second, it will be apparent that the interposition of a film of oil between the air and water must have a powerful effect in preventing breaking crests.

Observation has shown that, in the generation of oscillatory waves, ripples or capillary waves are first formed, and that it is to the union of conterminal ripples and to their more abundant formation with the increased force of the wind that the growth of waves is due. The existence of a certain definite tension, equal to ·08235 gramme per lineal centimetre, at the common surface of air and water has been pointed out. The water surface under this tension is in perfect equilibrium.

When wind blows over the surface of a body of water, the tangential force which the air, in virtue of its viscosity, exerts on the surface of the water, is of different degrees of intensity at different places, owing to the minute corrugations which are always present on the surface of a body of water, and to the eddying motion of the air. At the places where the tangential force is greatest, the surface film of water is drawn along and the portions of the surface immediately in front of them, destroying their surface tension or energy of position, and, by laying bare new surface in places from which they are moved, generating a like amount of surface tension. Through this action heaps or ripples are formed, and surface tension is being constantly generated and destroyed. The formation of ripples takes place on waves already in exist-

ence in the same manner as upon a surface of water originally at rest, and by continually uniting with the larger waves they impart those dangerous qualities to the wave which result from high and acuminate crests.

When a film of oil is spread over the surface of the water, this heaping-up action, which in the case of the water film results in the formation of ripples, can not take place. In the figure, let A represent the crest of a wave covered by the film of oil B C, and let P be a point of greatest action of the tangential force of the wind, which is supposed to move in the direction of the arrow. The tendency of this action is to drive the film into a heap immediately in front of P. By this action a greater tension is generated in the film at *b* and a lesser tension at *a*. The greater tension at *b* tends to draw the portion at *b′* ahead, and the lesser tension at *a* allows the tension at *a′* to draw the portion at *a* ahead; so that, instead of a tendency toward heaping up, there is a tendency to move the entire surface film along at a uniform rate. The formation of ripples is therefore stopped, and the growth of waves and the formation of breaking crests, as far as they result from this cause, are prevented.

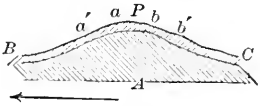


FIG. 7.

# HOW PLANTS AND ANIMALS GROW.

BY DR. MANLY MILES.

TOO little is known in regard to the chemistry of foods, or the specific use made of their proximate constituents in the processes of nutrition, to serve as a rational guide in formulating diets, or estimating the relative nutritive value of different articles of food. Our methods of chemical investigation are not as yet sufficiently delicate and refined to enable us to trace the unobtrusive transformations of matter and energy involved in the nutrition of living beings.

Liebig's chemical theories of nutrition are now discarded by physiologists as fallacious and misleading, but they are, nevertheless, confidently adopted by popular writers on the economy of foods and diets, who are not aware of the progress made in a more consistent knowledge of physiological processes. The history of biological science furnishes numerous instances of error arising from the undue prominence given to non-essential details which are readily observed, while the dominant factors in the phenomena under investigation, which are not so obvious, are overlooked or assigned a subordinate position.

The progressive development of the cell theory of organic structure, and the several steps which have led to a recognition of protoplasm as a factor in evolution and in the processes of vegetable and animal nutrition, may be profitably reviewed to illustrate the erroneous inferences made from superficial and defective observation. In 1755 Rosenhoff described the *Proteus* animalcule, now familiarly known as the *Amœba*, without being aware of the importance of the discovery in furnishing a type of the form or conditions of matter required for the manifestations of life.

Bichat laid the foundation for the study of the minute structure of animals in his work on anatomy, published in 1801, in which the different organs of the body were described as made up of tissues, to each of which was assigned a special function, and the attention of anatomists was then given to the distribution and arrangement of these structural elements, while their intimate relations, arising from a common origin, were not detected.

The next step of real progress was made in 1838 by Schleiden, who traced all vegetable tissues to the common form of nucleated cells from which they had their origin, and in 1839 Schwann perfected the cell theory of organization by extending the same conception to animal tissues. Cells were then recognized as the ultimate units of organic structure, which were variously modified to adapt them to diverse special purposes. This cell theory of organized structure was generally adopted, and cells were defined as closed membranes or sacs, containing a more or less fluid substance which served to nourish them. The cells were looked upon as independent units, which multiplied by a process of budding or by self-division, and a new factor was introduced in the discussion of the mooted question as to what constitutes the individual in plants. Schwann "regarded the plant as a cell community in which the separate elements were like the bees in a swarm," and this appeared to be a logical inference from the accepted cell theory of organization.

This view was, however, based on an erroneous assumption as to the essential constituents of the cell, and the progress of discovery gradually led to the demonstration of a material and physiological bond of union in the various tissues of plants. In 1835 Dujardin made the discovery that the bodies of *Foraminifera*, a group of animals of simple organization, including the *Amœba*, were composed of a glairy contractile substance, which he called *sarcode* (rudimentary flesh), and in 1846 Von Mohl called attention to the importance of the inner lining of the cell wall of plants, which he designated the *primordial utricle*, with its inclosed contents, to which he gave the name of *protoplasm* (primitive plastic or organizable matter), and these, he claimed, repre-

sented the essential constituents of the cell and active elements in plant nutrition.

The identity in essential features of Dujardin's sarcode and Von Mohl's protoplasm was pointed out by Cohn in 1850, and fully demonstrated by Max Schultze in 1858, who, adopting the term *protoplasm*, defined the cell as "a unit-mass of nucleated protoplasm, with or without a cell wall," and vegetable and animal physiology were thus placed on a common correlated basis. The original cell theory was materially modified and, in fact, superseded by the conception that the units of organized structure are masses of protoplasm, more or less intimately related, from and by which organic matters, including the cells and various tissues, were formed.

In 1868 Prof. Huxley translated protoplasm into the significant phrase, "the physical basis of life," and all vital activities were assumed to be the result of its inherent properties. While admitting the general pertinence of this assumption, we should not fail to notice that many of the inferences from the facts then known have not been verified in the progress of knowledge, and recent investigations have materially modified our views as to the real composition and constitution of protoplasm.

From what was known in regard to protoplasm twenty years ago, it appeared to be reasonable to assume with Huxley that there is "one kind of matter which is common to all living beings, and that their endless diversities are bound together by a physical as well as an ideal unity"; that vegetable and animal protoplasm are strictly identical; that "an animal can not make protoplasm, but must take it ready made from some other animal or some plant"; or, in other words, that the protoplasm made by plants from mineral matters is, in fact, the physical basis of animal life.

At the present time we may look upon protoplasm as the physical basis of life in the sense that some form of it is the essential and active constituent of every living cell or tissue, whether vegetable or animal, and that it is only formed through the physiological activities of living organisms. In the absence of life, protoplasm can not be formed, and, so far as we can perceive, there are no manifestations of life without it; but we can no longer assume that it is a substance of the same chemical composition and constitution in all the varied conditions under which it appears in the different groups of plants and animals, or even in the different organs of the same individual. Protoplasm is a convenient name for living substance, but we must bear in mind that it is the most complex and unstable of organic substances, and varies widely in structure, specific properties, and probably in chemical composition.

The general properties of protoplasm may be readily observed in the simplest organic forms, like the *Amœba*, that are usually described as simple masses of protoplasm without structure or any distinction of parts. It should be remarked, however, that numerous species of *Amœba* have been described, differing in form and to some extent in habits, and there may also be differences in their protoplasm which we are unable to detect with our present means of investigation.

Under the low powers of the microscope an *Amœba* appears as a semi-transparent, jelly-like mass, which glides along with a flowing movement of its apparently homogeneous substance, sending out armlike projections from any part of its body to close around substances which it can feed upon, and rejecting other materials unsuitable for its nutrition. The processes of prehension, digestion, assimilation, respiration, excretion, and reproduction are carried on by the entire body, or by any part of it indifferently. The body of an *Amœba*, as we observe it, is not, however, a simple mass of protoplasm, as it evidently contains particles of undigested food, with particles representing the various stages the elements of the food pass through in being built up into protoplasm, together with the various waste products on the way to be excreted, so that what we call protoplasm, as represented in an *Amœba*, contains many extraneous substances; and substantially the same statement may also be made in regard to the differentiated protoplasm of the higher plants and animals.

From this it must be seen that it is practically impossible to obtain samples of pure protoplasm for analysis, and, even if this could be done, a chemical analysis of living protoplasm can not be made; but there is, however, evidence to show that there must be a wide difference in the chemical properties of living and of dead protoplasm. Carmine and other coloring matters, for example, do not color living protoplasm, but give a brilliant stain to dead protoplasm; and other observations show that living substance has properties that interfere with or limit the ordinary chemical and physical reactions of dead matter.

There are other considerations in regard to the composition of protoplasm which require a reference to the food of the higher animals, which is usually said to consist of the so-called proteids, fats, and carbohydrates, to which should be added certain mineral constituents or salts, with oxygen introduced by the lungs. These groups of food-stuffs have not the physiological significance that was formerly attached to them, and they do not represent definite chemical compounds which have a specific *rôle* in the processes of nutrition, as each group includes a great variety of complex compounds. The proteids or albuminoids, as they are sometimes called, are a group of organic substances containing carbon, hy-

drogen, and oxygen, with from fifteen to eighteen per cent of nitrogen and a variable quantity of ash constituents, and they present marked differences in their general appearance and properties. The white of an egg, the casein of cheese, the glutin of wheat, and the legumin of peas and beans are often referred to as typical proteids, but they in fact represent several kinds of proteids which differ in many properties, and can not be assumed to have precisely the same physiological significance and value as nutrients.

The group of fats includes a great variety of compounds composed of carbon, hydrogen, and oxygen, without nitrogen, and their properties are various. The carbohydrates are likewise composed of carbon, hydrogen, and oxygen, without nitrogen, and they include starch, sugar, cellulose, woody fiber, and allied substances, differing in form and various properties, so that their physiological value can not be the same. Oxygen is the most abundant element of the animal body as a whole, and it stands next to carbon in the percentage composition of the proximate constituents of the tissues. Its significance as a food element is too often overlooked, but it is undoubtedly as important a factor in tissue-building as any other food constituent.

Protoplasm was formerly looked upon as a proteid, but it is now generally admitted that its composition and structure are very much more complex than any form of proteid. The chemical composition of living protoplasm, as already pointed out, can not be determined, but there is evidence that proteids, fats, and carbohydrates enter into the composition of its complex molecules, and it gives rise to all three of these groups of nutrients in the processes of destructive metabolism, and it should also be noted that several varieties of proteid matter have been detected in dead protoplasm.

Energy has been defined as the power of doing work, and it is expended in the work involved in building protoplasm out of the simpler proteids, fats, and carbohydrates from which it is formed. An essential constituent of the complex molecules of protoplasm which is neglected in chemical analysis is the potential energy stored up as a result of the constructive process, which is liberated in the form of heat in destructive metabolism. The properties of living protoplasm, and its *rôle* in the vital activities of plants and animals, have been more definitely determined than its chemical constitution, and although it is generally admitted to be the dominant factor in nutrition, there is yet much to learn in regard to its properties and specific action in its diverse forms.

Living protoplasm, or, in other words, living substance, must be looked upon as constantly undergoing changes that vary with the function required of it. These changes, without attempting

to distinguish between them as chemical, physical, or more strictly biological, are conveniently expressed by the general term *metabolism.*

Dr. M. Foster says: "We may picture to ourselves this total change which we denote by the term 'metabolism' as consisting, on the one hand, of a downward series of changes (katabolic changes), a stair of many steps, in which more complex bodies are broken down into simpler and simpler waste bodies, and, on the other hand, of an upward series of changes (anabolic changes), also a stair of many steps, by which the dead food, of varying simplicity or complexity, is, with the further assumption of energy, built up into more and more complex bodies. The summit of this double stair we call 'protoplasm.' Whether we have the right to speak of it as a single body in the chemical sense of that word, or as a mixture in some way of several bodies; whether we should regard it as the very summit of the double stair, or as embracing as well the topmost steps on either side, we can not at present tell. Even if there be a single substance forming the summit, its existence is absolutely temporary: at one instant it is made, at the next it is unmade. Matter which is passing through the phase of life rolls up the ascending steps to the top, and forthwith rolls down on the other side."

The greater activity of the nutritive processes in young and growing animals, with a gradual decline to maturity and old age, are matters of common observation. Dr. Minot has, however, shown that "with the increasing development of the organism and its advance in age we find an increase in the amount of protoplasm.* This seems to indicate that katabolism is relatively more active in young organisms, and that they use protoplasm in tissue-building as fast as it is formed. In old age, on the other hand, the anabolic processes resulting in the formation of protoplasm are not diminished as rapidly as the katabolic transformations of protoplasm into new tissues, to replace the waste arising from the wear and tear of the system, and a general decline of the bodily powers follows.

As we pass from the simpler to the higher forms of life we find a gradual transition from the comparatively homogeneous protoplasm of the lowest, to the highly differentiated protoplasm of the highest forms which provide for a division of labor in the physiological activities of the different organs. In the highest organisms the functions of prehension, digestion, assimilation, respiration, etc., as in the *Amœba*, are still carried on through the agency of protoplasm, but it is distributed to various organs, each of which has a special function.

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* Trans. A. A. A. S., 1890, p. 283.

Plant cells are not independent units as assumed in the cell theory of organic structure, as recent investigations, with improved microscopes and more exact methods of research, have shown that the protoplasm of adjacent cells is connected by slender threads which pass through minute openings in the cell walls, and this has been observed in so many cases that the continuity of their protoplasm is believed to be the rule in the structure of plants. The various tissues and cells of the higher plants have, therefore, a common bond of union in the connecting threads of protoplasm which determine their harmonious action.

The higher powers of the microscope likewise show that the protoplasm of plants is not homogeneous, but contains numerous granules which repeat themselves indefinitely by a process of self-division, each granule having a genetic relation to pre-existing granules of the same kind. Besides the granules, each protoplasmic cell has a nucleus which in the same manner is formed by the self-division of a pre-existing nucleus. The granules, and especially the nucleus, may prove to be important factors in the perpetuation of ancestral characters, and consequently more intimately involved than other elements in the grand mystery of life.

The chlorophyll granules which constitute the green coloring matter of plants were supposed to be formed from the protoplasm in which they appear; but they are now known to arise from the pre-existing self-propagating granules of protoplasm.

The conception of ascending steps of constructive metabolism resulting in the formation of protoplasm and the storing of energy, with correlated descending steps, by which protoplasm is transformed into less complex compounds (destructive metabolism), with a liberation of energy, serves as a key to the complex processes of nutrition which enables us to trace their conformity to general laws that are readily recognized, and clears up the obscurity arising from the multiplicity of details which from other points of view could not be brought into consistent relations.

In the light of these principles the relations of protoplasm to the leading features of vegetable nutrition may be traced in brief outlines, as a prelude to the more highly differentiated processes of animal nutrition. The latest discoveries in physiology all tend to verify the conclusion that the simple chemical elements and binary compounds, which constitute the food of plants, are built up by successive steps of gradually increasing complexity into protoplasm, or living substance, the ultimate product of constructive metabolism, and that the energy expended in the work performed is stored in the form of potential energy as an essential element or condition of its constitution. From the instability of the exceedingly complex molecules of protoplasm, destructive metabolism immediately follows, and the proximate constituents

of plants known as proteids, starch, cellulose, etc., are formed in the downward steps of its progress with a liberation of a portion of the stored energy in the form of heat. The heat liberated in these first steps of destructive metabolism is not, however, sufficient to maintain an independent temperature in plants, as it is used in vaporizing the water exhaled in the processes of growth, or lost by radiation from the extended surface of foliage. The energy expended in vaporizing water must be considerable, as experiments show that for each pound of dry organic substance formed by the plant about three hundred pounds of water are exhaled in the form of vapor.*

The products of the downward steps of metabolism are numerous, some of which, as waste matters, are either excreted, as in the case of carbonic acid and water, or deposited in the more stable tissues; while others called plastic products, including proteids, starch, fats, etc., are stored as reserve materials to be used in constructive metabolism when needed by the plant. These reserve materials are not as a general rule stored in the place where they are formed, and they can only be transported when changed to a soluble form, which is brought about by certain "soluble ferments," which are also products of the destructive metabolism of protoplasm. Starch formed in the leaves is changed to glucose and transported to other parts of the plants where it is reconverted into starch and stored for use, sooner or later, in constructive metabolism. Some of these reserve materials are apparently built up again into protoplasm before they are resolved into their ultimate products. This is seen in the starch deposited in oily seeds which is used in forming protoplasm, and the oil is then formed as a product of its metabolism.

The many forms of organic acids—as the malic, tartaric, oxalic, citric, etc.—and a variety of alkaloids and other bodies are also products of destructive metabolism, which may be deposited in the various tissues as waste materials, or some of them may be changed by soluble ferments into forms which may be again utilized in the economy of the plant. The organic acids and tannin of green fruits, for example, are converted into sugar in the process of ripening by ferments formed from the protoplasm of the fruit cells.

In general terms the processes of nutrition in plants may, then, be said to consist in the construction of protoplasm from the elements of their food, with a storing of energy, and the conversion of this protoplasm into the various organic substances entering into the composition of their tissues (starch, cellulose, etc.), with a liberation of energy, and all vital activities are included in

* Popular Science Monthly, May, 1892, p. 92.

these upward and downward transformations of matter and energy.

In the higher animals the various functions are more highly specialized, but we still find that protoplasm is the essential living substance of every tissue and the dominant factor in nutrition. It differs, however, from vegetable protoplasm in many of its properties, and it can not, as formerly assumed, be formed by plants, or built up from the simpler elements that plants feed on, and from which they construct vegetable protoplasm.

The proteids, fats, and carbohydrates which constitute the food of animals are, as we have seen, products of the destructive metabolism of the protoplasm of plants, and it was formerly supposed that they are transformed into animal proteids and fats, without any marked change in their chemical constitution. This assumption is, in fact, the basis of the fallacious theory of nutritive ratios, but it can not be reconciled with the known facts of animal nutrition. There appears to be conclusive evidence that the proteids, fats, and carbohydrates of the food can not be converted into the proteids and fats of the animal body without undergoing profound disruption and reconstruction through the agency of animal protoplasm; or, in other words, the products of vegetable protoplasm can not be made available in the construction of animal tissues without being resolved into simpler compounds and formed anew in the laboratory of animal life.

Without noticing the many details that would only tend to divert the attention of the general reader from the significance of the results produced, the essential or fundamental processes in the nutrition of the higher animals may be broadly stated as follows: In the first place, the proteids, fats, and carbohydrates of their food undergo a series of changes in the processes of digestion (using this word in its widest sense) that reduces them to simpler compounds and, in fact, almost to their elements, with a liberation of energy which is made available in the reconstruction of the disintegrated food constituents.

The activities of the various organs of nutrition are primarily directed to the elaboration of a nutritive fluid, the blood, which is distributed to all of the tissues through the circulatory apparatus provided for that purpose, funishing them the pabulum for their nutrition, and receiving the excretory and other products arising from their metabolism. "An average uniform composition of the blood" is maintained through the action of numerous glandular organs, and the drafts made upon it in the constant repair of the different tissues. The various ferments required in the disintegration or digestion of the food elements that are being transformed into blood are products of the destructive metabo-

lism of the protoplasm of the special secreting organs and of the general tissues.

From the common nutritive fluid, the blood, protoplasm is formed in all the tissues of the body, and we must look upon the characteristic elements and products of these tissues as the result of its destructive metabolism. In each organ of the body the protoplasm appears to have special endowments adapted to their specific functions, but these diverse activities are correlated to serve a common purpose in the life of the individual. The contraction of muscles, the specific secretions of the glandular organs, including the salivary glands, the liver, the pancreas, the mammary glands, etc., and, in fact, the products of all the metabolic tissues, as well as their characteristic structural elements, must be considered as the resulting products of the downward steps of the metabolism of protoplasm.

As in plants the food elements are built up into protoplasm before they are converted into the proximate constituents of plant tissues (proteids, fats, starch, etc.), so in animal nutrition it appears that the proteids, fats, and carbohydrates, together with oxygen introduced by the lungs, which constitute their food, must pass through the intermediate phases of blood and protoplasm before they appear as animal proteids and fats, or enter into the composition of the different tissues of the animal body, so that a genetic or specific relation of particular tissues to special food constituents can not be traced.

For example, the muscles, from their comparative bulk, contain a large proportion of the nitrogen of the body, and they are spoken of as nitrogenous tissues, but they are not formed directly from the proteid or nitrogenous constituents of the food. Like all other tissues, they have their origin in protoplasm that is built up from the common nutritive fluid, the blood, which is elaborated, as we have seen, from the disintegrated elements of fats and carbohydrates as well as proteids. Moreover, nitrogen is no more essential to the formation of muscle than carbon or oxygen, or even water, which are more abundant constituents of all living tissues.

It must then be evident that we can not formulate the proportions of the proximate principles of foods that will serve the best purpose in animal nutrition. The extended and profound series of changes that intervene between the food constituents on the one hand and the resulting animal tissues on the other are too complex to enable us to trace any direct chemical relations between the initial elements and their final products. Aside from these physiological considerations there are insuperable obstacles in the way of prescribing diets that are even approximately suited to the requirements of any particular individual, or group of

animals, arising from individual peculiarities and inherited ancestral habits. Experiments have not as yet been made with a sufficient number of individuals or with a sufficient variety of foods to warrant any generalizations as to what constitutes a normal diet for either man or beast under even average conditions.

The recent recognition of energy as one of the most important factors in physiology has led to the rejection of the purely chemical theories that were formerly quite generally accepted in regard to the *rôle* of particular food constituents in the processes of nutrition. An assumed combustion of food constituents is no longer required to explain the phenomena of animal heat, which is now known to be but a phase in the transformations of energy in the processes of nutrition.

Energy is expended in building organic substance, or, in other words, in converting food-stuffs of any kind into protoplasm, the summit of the double stair of life, and its potential energy is the transformed or stored energy of the constructive process. This combined energy, in accordance with the law of conservation, may be liberated in the form of heat to a greater or less extent in various ways by the more or less complete disintegration of the organic substance in which it is stored. If the process of disintegration is carried on until the organic substance is resolved into its original elements, the heat liberated is the exact equivalent of the energy expended in its construction.

In living organisms the descending steps of metabolism are but successive phases of normal vital activities, resulting in the formation of a definite series of organic substances which contain less potential energy than the protoplasm from which they are formed, and heat must therefore be liberated as they are elaborated. Dead organic matters may be torn apart by microbes and resolved by a widely different series of descending steps into their original elements, as in the processes of fermentation and putrefaction, with a complete transformation of their potential energy into heat. The same ultimate result may likewise be obtained by burning organic substances, but the intervening steps and products of the destructive process are less numerous and of a different character than those produced by vital activities, while the heat liberated is still the transformed energy of the constructive process.

Plants derive the energy required to convert simple chemical elements into the complex molecules of protoplasm from the heat and light of the sun, while on the other hand the energy expended in the constructive processes of animals is exclusively derived from the potential energy of their food (stored energy of plants), and a disintegration and apparent waste of the material, or chem-

ical constituents of foods, become necessary to liberate their needed supplies of energy.

As all the food constituents contribute to the blood-making processes, they all in like manner through digestive disintegration contribute to the supplies of energy required in the animal economy. The energy provided in foods in the potential form is quite as important in building animal tissues as the chemical elements entering into their composition, as when liberated in the form of heat it is utilized in constructive metabolism and stored again as potential energy in the animal tissues formed. The destructive metabolism taking place in these tissues, as an essential concomitant of their vital activities, again liberates energy in the form of heat, which, with that derived from the digestion of foods, is used, so far as needed, in the reconstructive process, and the balance appears as animal heat.

We have noticed the recently discovered continuity of the protoplasm of plants, but we can not fairly infer that there is a similar continuity of the protoplasm of the higher animals that have a highly specialized nervous system which brings the different organs and functions into harmonious action more completely and efficiently than they could be by simple threads of protoplasm like those which unite the cells of plants. The widely different products of destructive metabolism in the various tissues of plants and animals, aside from other considerations, furnish conclusive evidence that while the general *rôle* of protoplasm is everywhere the same, it must differ materially in composition and constitution in the different conditions in which it is found. As stated by Dr. Foster, "It is obvious that the varieties of protoplasm are numerous, indeed almost innumerable. The muscular protoplasm which brings forth a contractile katastate must differ in nature, in composition—that is, in construction—from glandular protoplasm whose katastate is a mother of ferment. Further, the protoplasm of the swiftly contracting striped muscular fiber must differ from that of the torpid, smooth, unstriated fiber; the protoplasm of human muscle must differ from that of a sheep or frog; the protoplasm of one muscle must differ from that of another muscle in the same kind of animal, and the protoplasm of Smith's biceps must differ from that of Jones's."

What determines these differences and gives direction to such diverse metabolic activities? Chemical and physical considerations fail to clear up the mystery of life and its varied manifestations. We may look upon protoplasm as the physical basis of life, and consider vital activities as resulting from its inherent properties; but this does not aid us in gaining a better knowledge of the mysterious endowments of living matter. What gives rise to these diverse properties in different species and in different

organs of the same individual? We can not attribute them to organization or structure, as so far as we know these are the result of vital activities, and can not, therefore, be the cause. As forcibly stated by Prof. Huxley in his paper on the cell theory (1852), cells "are no more the producers of the vital phenomena than the shells scattered in orderly lines along the sea-beach are the instruments by which the gravitative force of the moon acts upon the ocean. Like these, the cells mark only where the vital tides have been and how they have acted."

It has been suggested that the various factors in nutrition, including even "structure" and "composition," must be looked upon as modes of motion in accordance with the concepts of modern physics, and from this point of view the body of a man has been compared to a fountain. "As the figure of the fountain remains the same, though fresh water is continuously rising and falling, so the body seems the same, though fresh food is always replacing the old man, which in turn is always falling back to dust. And the conception which we are urging now is one which carries an analogous idea into the study of all molecular phenomena of the body."

The pertinence and significance of these physical considerations should not, however, lead us to assume that life is but a form of energy. We can not doubt that energy is the motive power in living beings, and that its transformations and activities which are evident in all organic processes are properly considered as modes of motion, but we must discriminate between the motive power that does the work and the directing force which guides it in the lines along which it acts and determines the results produced. We are unable to detect any difference in the potential energy of living and of dead protoplasm, but we recognize an immense difference in their significant properties—a difference so wide that life can not be defined as a form of energy.

The manifestations of energy in organic processes are readily perceived, and there are definite standards with which to measure them, but our most delicate means of research throw no light on the purely vital endowments of protoplasm, which not only direct and control its activities, but are transmitted in well-defined characters from parent to offspring. There is no life without preexisting life from which it is derived, and the physical basis through which it acts, or is made manifest, furnishes no satisfactory explanation as to its real essence and constitution.

In discussing the economies of foods and diets, if we keep in mind the significant facts that vital activities direct and determine the transformations of energy and the collocations of matter in plants and animals, in accordance with the nutritive requirements of every organ and tissue, and that in the higher animals

the food supplies of the various tissues that differ so widely in composition and function are derived from the same common pabulum, the blood, which under the varying conditions of supply and demand maintains a comparatively uniform composition—the futility of assigning to each or any element of the food a specific *rôle* in the processes of nutrition must be obvious.

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## THE REVIVAL OF WITCHCRAFT.

By ERNEST HART.

II.

FINALLY, I must refer to another set of experiments which Dr. Luys conducted before us at La Charité on two of the patients there (on whom I subsequently performed counter-experiments). Having thrown these patients into the state of artificial sleep, he took from his pocket some sealed glass tubes. "This tube," he said, "contains alcohol." He placed the tube in contact with the skin of the patient inside the collar of her dress. After a minute she began to complain of feeling giddy and oppressed. Presently she manifested all the signs of incipient drunkenness—she was gay and disposed to sing. A little later she fell from the chair on to the floor in a state of complete inebriety, and with a simulation of the various stages of drunkenness so effectively dramatic that I doubt if any woman so uneducated could go through such a performance, except an hysteric of this class, when "sleep-waking" and freed from the restraint of the fully conscious action of the upper brain. It is this mixture of hysteria, partially numbed consciousness, trained automatism, and imposture, which so often takes in either the wholly credulous or ignorantly skeptical spectator. Of the imposture there was, as I shall presently show, *pace* the intelligent reporters, no doubt whatever. Nor do I doubt at any rate that this girl was a thorough-paced hysteric and trained hypnotic, and that she was in an artificially induced and pathological condition when she went through these elaborate and brilliantly performed antics. She was lifted into the chair and another hypnotized person placed alongside her in another chair. Their hands were clasped together. "We will now see," said Dr. Luys, whether "the vibrations will be communicated from one to the other," and the state of drunkenness transferred. So said, so done; and a similar performance, not, however, so skillfully executed, was gone through by the second and less experienced subject. On the following day we had yet a more picturesque performance. I was told beforehand that this was "the day of the cat," and that I might expect to see a highly trained sub-

ject who usually presented herself at the *clinique* on that day for what was commonly spoken of as "the cat performance." This was a Mlle. V., much described by Dr. Luys in his *Leçons Cliniques sur les Phénomènes de l'Hypnotisme.*

Of her Dr. Luys speaks as follows in his lectures to his pupils, to whom he presents her in set phrase as "an example of the degree of exaltation which memory and imagination may acquire in certain somnambulic subjects when other regions of the brain are in the condition of functional inhibition."

Here is Mlle. V., a professor of foreign languages, who is endowed with exquisite sensibility for hypnotic phenomena. For her, hypnotization has become an aetnal necessity, like morphine for morphinomaniacs. She is interested in all questions of this kind, for some time she followed punctually all the lectures which I gave here, and, as you will see, when I ask her if it interests her, she replies that she comes with pleasure, but she understands nothing about it; it is too technical. She only comes, she says, to assist in the experimental part of my lectures, and now when I question her she will tell you that she has not retained anything in her mind; that she has a very bad memory, and that she is incapable of giving the least account of the matter. That is what she is in the normal state, as you see, and you can accept the sincerity of her words. Now I will throw her into somnambulism, and you will see that the picture will change altogether. I say to her: "You are no longer Mlle. V., you are M. Luys, you are at the Charité, in his amphitheatre, and you are going to give his lecture on suggestion in his place." You see, she accepts my words with docility; she incarnates herself in my person; she takes my habits of language and of gesture, and, once started, you see with what facility, although a foreigner, she talks French, and with what correct sequence of ideas her explanations are given. She is never wrong; she finds the correct technical word; she varies her intonations, and presents really the innate qualities of a professor. More than that, you will now see a curious scene. I have a subject brought in and, placed in this arm-chair in front of her, tell her, "Here is a hypnotizable subject, whom you will send to sleep," and you will be surprised to see her repeat point by point the various proceedings for producing hypnosis; she explains to you accurately the symptomatic characters of lethargy, those of catalepsy, of somnambulism, in which state she is herself at this moment actually plunged, the different peculiarities belonging to these various states, details of the habits and manners peculiar to hypnotics, and, if I were not to interrupt her, she would go on talking thus for whole hours, until her strength was completely exhausted, and she would fall back again into lethargy.

This account of this remarkable person, which I had read beforehand, so much interested me that I was desirous to see her, and very sorry that she was not there on the usual day to play the cat. But not to disappoint us, the male patient, of whom I have spoken, was introduced in her place. He was rapidly hypnotized by holding a finger in front of his eyes, and when he had arrived at the proper stage Dr. Luys took out a tube and said, "We will try the valerian on him, but I am not sure it will succeed." The tube was, however, put inside his coat-collar in contact with his skin. Presently he became very uneasy, disturbed

in countenance, and moving awkwardly about in the chair. I asked him what was the matter. "He can not answer you," said Dr. Luys; "he is dumb, he can not speak; he is transformed; he is no longer a man and can not use the speech of men; he is assuming the nature of a cat." And, sure enough, presently the unhappy creature threw himself on to the ground with every sign of excitement and congestion; he began scratching about the floor on all fours, and presently mewing like a cat—a disagreeable but striking imitation—and when the valerian tube was taken from his neck and held in front of him he came scratching and spitting along the floor on all fours, as though irresistibly attracted, as a cat might be, to the person who held it. This astonishing gymnastic lasted for some minutes and seemed to fatigue him, as well it might. On the following day I secured the presence in my apartments of Mlle. V. above mentioned. On calling on her with M. Cremière I found her installed as a hypnotizer as well as a hypnotic subject, and with a plate on her door accordingly. We arranged for a *séance* on her usual terms. She insisted, however, on bringing "her subject" with her, for she apparently now finds the passive and performing state rather fatiguing and not sufficiently profitable, and prefers the *double emploi*. When she arrived a very amusing scene followed. Acting Dr. Luys to the life, she proceeded to place her subject before her, and began to give us the magistral demonstration based on his lectures on suggestion, which he describes above as the peculiar endowment of her somnambulistic condition, and of which, as he observes artlessly, he believes her to be quite incapable in her waking state, thinking it only possible when her faculties are peculiarly "exalted" by his manipulation. I have no doubt that, as he says, she would have gone on indefinitely and until she was exhausted; but we were very soon tired of her glib impudence, and stopped the performance after she had shown us how she had trained this new subject in three weeks to a number of the required manifestations. We had the "passional attitudes," "fascination," the *prise du regard*, etc. The eyelids were duly opened by order for further performances, for she intelligently observed:

The eyelids, gentlemen, are the windows of the soul, are they not? and in order that her heightened faculties may acquire their full perception, the light must penetrate; but she sees only me, she knows nothing of what goes on around her, she thinks my thoughts, she is *en rapport* with me alone.

Here we stopped her, for we were beginning to be fatigued, although she was not. We now requested herself to become the subject, and duly regretted her absence at the *clinique* of Dr. Luys on the previous day.

Oh (she said), I am very sorry I was not there, but I did not come because it is the off season. At the New Year every one is making holiday; very few peo-

ple come to the *clinique*, and there are not many strangers, and so I was told that it was not worth while my coming for the next week or two, and Dr. Luys did not expect me.

She then gave us a long list of her capacities, which run through the whole gamut of the phenomena described in the volumes of the professor at La Charité. She was duly put to sleep, and then I produced my tube. I had on the mantelpiece a number of tubes which I had taken at random from the laboratory of my brother-in-law, M. Vignal, containing a great variety of crystalline substances. These, however, she had already spied on the mantelpiece on coming in, and she said, "Oh, I must warn you that I am not at all susceptible to dry powders in tubes, only to fluids, and you won't get any effects with those." Respecting her scientific prudery and affected hypnotic exclusiveness, I humored her by immediately sending to the neighboring chemist for some tubes containing alcohol, valerian, cherry-laurel water, distilled water, and solution of burned sugar. One of the medical frequenters of the Charité was kind enough to go and get them, and he was good enough to see also that all the tubes were incorrectly labeled. A private mark on the corks indicated the true contents, which were duly entered in the notes of the sitting. I now said to him, "Kindly give me the valerian," in a low voice which she was supposed not to hear. This was duly placed in contact with the skin of the neck, the actual contents of the tube being *alcohol*. Then came the cat performance to perfection. I will do Jeanne (the other name under which this lady will be found spoken of in the lectures of Dr. Luys) the justice to say that she was by far the most accomplished performer of the three of his subjects whom I saw go through this performance at my rooms and at the Charité under similar circumstances. She scratched, she mewed to perfection, she washed imaginary whiskers, she spat, she licked her hands, she lapped milk from a saucer; and when you "pressed the button" at her back she sat up rigid as on hind quarters and caressed her face with her paws with a truly feline grace. She came back to her chair, or was supported back, for she was still supposed to be in deep somnambulism, and we brought into use the tube which was *labeled* cherry-laurel water, but which really contained valerian. Now commenced another performance, which among the trained subjects of the Charité is supposed to be identified with the "effect at a distance" of the fluid described on the label. After a decent period of waiting she fell slowly on her knees, her face assumed the characters of ecstasy, her eyes were fixed on space, and her features composed with great art to an affected expression of pious rapture; the hands were held up imploringly, then her head dropped and her arms folded across her breast as in prayer. Her hands presently were extended and her

face upturned as toward a vision of beauty, and she exclaimed in low and broken tones of rapturous emotion: "She comes, she comes; she is all in white!" and as this sacred vision died away her head dropped in solemn resignation, and after a short interval of resignation and grief the play was over, and she was brought back once more to her chair in a state of well-simulated lethargy. This same performance she repeated under similar conditions at the final *séance* at Dr. Sajous's rooms, where I organized a continued representation before a number of spectators by Jeanne, by Madame Vix, and Clarice, in all cases with tubes containing anything else but valerians. Clarice was a third subject who figures largely in the writings of Dr. Luys, and whom I met at his *clinique*. She also was for a long time a patient; she is a thorough hysteric and trained hypnotic, and she goes through some of these performances with even better grace and more seductive accomplishment than Madame Jeanne. We repeated with her twice all these performances, and also some others. For Clarice is now also a "professional"; she is younger and prettier, and charges a higher fee than that of the others; she has hypnotic specialties of her own. She requested that for the final *séance* she might be permitted to bring "her *pianiste*," for she told us that what she was particularly celebrated for were the beauty and grace of her *attitudes passionnelles*, which were best performed when the person who hypnotized her could play to her appropriate music, gay or melancholy. Accordingly, on the final occasion, she came with a pianist, who duly made a few customary passes, to put her into the somnambulistic state, then put her in the middle of the room and began playing suitable music. He supplied her with castanets, and she danced a gay and lively measure; he rose from the piano and took them from her, and then sad music threw her into attitudes of picturesque despair and delicately acted grief. We had no time to go through the whole performance, or I have no doubt it would have been well worth the money. I need not go through the entire category of proceedings. Prof. Luys told us that he had had as many as three of these people at once engaged in their cat performance, licking their paws, mewing, jumping, and scratching about the place; as he said, "un véritable Sabbat"—a true witches' Sabbath. He dwelt upon the importance of these manifestations (which he takes quite seriously) as opening up new realms of psychological inquiry. I quote from my notes:

Here (he said) is a new domain for psychical researches. It will enable us, at any rate, to catch glimpses of the animal mind, and perhaps to learn what they feel and think. I had a patient who in the somnambulistic stage was transformed into a cock and entered into the cock nature. I tried to make him remember when he awoke what he had been thinking of when he was thus trans-

formed, by ordering him to do so when still somnambulistic. I asked him what he had been doing. He said he had been crowing. I asked him why he crowed. He said he did not know, he crowed because he could not help it. I asked him what he had been thinking of, and his answer was, "Je pensais à mes poules" ("I was thinking of my hens").

This, however, appeared to be as far as we have yet got in this new excursion into psychical research of animals; it is not very instructive or edifying. So far as all these persons went they must be pronounced impudent impostors, and it is difficult to conceive how they can have succeeded in duping serious people, or how they can be permitted to have carried on the fraud for so many years. So also with the imaginary effects of the various medicinal substances in sealed tubes. I repeated this performance on every one of these five subjects of M. Luys, on whom he has for years been lecturing, whom he has photographed, and of whose good faith he gives so many assurances. We made notes (sometimes written by myself, sometimes by Dr. Sajous, sometimes by M. Cremière) of the results. The subjects were never once right, even by accident. When Mervel at the hospital supposed the tube to contain mercury although it really contained diabetic sugar, he suffered agonies of the kind which he supposed mercury to produce. He had gnawing pains; his limbs were being eaten away, and he was in dire agony from the worst effects which a prolonged mercurial course used often to produce, and of which the repute is still a tradition in the hospitals. Madame Vix, at my rooms, had another opinion of the effect of mercury, gathered apparently from its use in infantile ailments; for she was a mother. When she thought the tube contained mercury she began to suffer acute pains—"colique d'enfants," she said; and to stop the comedy I had to apply to her neck what was supposed to be a tube of cinnamon water, but which was really charged with bisulphide of mercury. This quickly calmed her pains, which were beginning to be indecorous. With Mervel at the hospital, when I had him to myself and hypnotized by the ward attendant, all the effects supposed to be due to valerian were produced with burned sugar. He was duly and quickly transformed into a cat, and the whole drama was enacted in the ward, but this time under the influence of a tube of sugar-water, with vivid feline effects. Strychnine, of which I was warned that the effects were most dangerous, for, as Dr. Luys observed to me, "You might kill a patient with it through incautiously applying the tube," I used repeatedly and most incautiously without producing any effects, for I was careful never to mention its name. I may emphasize that on this occasion it was not I who hypnotized Mervel, but a person who was well accustomed to do so.

Leaving now the detail of the various scenes of this tragi-

comedy, let us consider for a moment the interpretation of it and the lesson it teaches. It was not, I think, always and in all its stages wholly an imposture, although generally it was. Two at least of the subjects, Mervel and Marguerite, and, I think, perhaps Clarice, were pronounced hysterics and thoroughly trained hypnotics; they mingled pathological conditions and an artificially induced state of partial automatism with their abundant frauds. They were at once, as Voltaire puts it, speaking of like impostors, "duped and dupers, deceived and deceivers." Jeanne and Vix appeared to me from first to last to be acting a part with full consciousness of all their frauds. They were, moreover, anxious to accomplish them to my satisfaction, and in such a way, as they both openly stated, to procure from me what Jeanne called "a *réclame*" and Vix "the favor of my recommendation." After I was gone, Jeanne, the "professor of languages," and "sincere subject" of Dr. Luys's lectures, sent after me the following letter, which I think too interesting a document not to put upon record. I omit the address and the final paragraph, but I preserve the original spelling:

Monsieur le Docteur—Ayant eu l'honneur Samedie dernier de servir de Sujet à une Seance d'hypnotism chez vous, Monsieur le Docteur, j'espère que vous voudrez bien m'excuser, Monsieur le Docteur, la liberte que je prends de vous faire parvenir une petite nomenclature—des expériences et des phénomènes—que Mr. le Dr. Luys obtien, depuis bien tot 7 ans, sur moi.

1. On obtien sur moi tres facilement—

Les trois états classiques,

Léthargie, Catalepsie, Somnambulisme.

*En Léthargie*

Anestesie complète.

Tous les différents effects et contracture—au contacte—des differents Metaux.

Les Contractures Neuro-Musculaires.

Le jeu du Diaphragm.

*En Catalepsie*

Prise du regard—le point fixe—autométisme—les attitudes—Effets des Couleurs.

Suggestions par gestes.

*Effets des Aimants.*

Cessation du battement du poux.

*Raideur cadaverique.*

*Somnambulisme*

Tous les phénomènes de l'hyperestesie de la peau.

Les attractions.

Effects de medicaments à distance.

Suggestion—instantanée et à écheance.

Changement de personalité.

Mnemmonie.

Vision.
Vue *absolue* à travers tous les corps oppaques sans *aucun secour des yeux.*
Double vue—transmission des pensées.

Voila Mr. le Docteur les phénomènes qu'on obtien très facilement sur moi—*sans jamais les râter.* Mr. Le Docteur Luys n'hésitera pas à le confirmer—d'ailleurs j'offre de le prouver—quand on voudra.

Je travail en ce moment comme Sujet (passif) à la Charité avec Mr. le Dr. Louys—et comme Sujet *active* avec mes sujets—chez moi tous les jours de 2 heures a 6 heures—et dans tous les Salons de la haute Aristocratie Parisienne en soirée hypnotique ou Spirite.

Anciennements Mdlle. . . . que Samedi Mr. le Docteur j'avais aperçue dans votre Salon *— á été employée par moi—pendant 8 mois *comme mon sujet.* J'ai été forcé de la conjedier pour un fait—assez sérieux. Cette petite dont les aptitudes sont absolument aussi nules que le Cabotinage, est grand profité des visites chez moi de quelques toutes jeunes dames du plus grand monde qui dans l'après midi venaient me consulter et naturellement en cachette de moi, pour grossire ces gages de sujet, cette petite fille sans conscience vendai de la morphine au morphinomane et de l'opiome aux opiomanes, une de mes cliente, Mme. la Vicomtesse de . . . devenue absolument opiomane par l'opiom procurai en secret par . . . a manque payer cela de sa vie. Par un hasard ayant decouvert la verite j'ai mise . . . immediatement à la porte. Voila pourquoi j'ai été desagreablement impressionée voyant cette triste personne singer avec aplond dans le salon de Mr. le Docteur tous ce qu'elle m'avais vu faire étant chez moi.

This document is perfect; its spelling, its jargon, its revelation of the under side of the genuine "marvels" of the new and old mesmerism, will make it historic.

We see here to what excesses this so-called science of hypnotism may lead, and we catch a glimpse, and only a glimpse, of some of its evil connections. The rest remain to be followed out, and ought to be followed out, by the Paris police, and no doubt the administrative council which presides over the hospital system of Paris will take some steps in the matter. It is hardly possible (except under a system of highly concentrated centralization, in which the true central governing body is so far removed from its peripheral members as to take little notice of what is going on there) that such things should happen or should continue. In any English hospital in which the controlling governors are on the spot, and the staff in habitual communication with them, such proceedings would long before have attracted inquiry, and would have been controlled. That is by the way. How much harm they can do in some directions, M. Luys knows very well and expresses very clearly, for he says in his lectures: †

* This is another favorite subject of the Charité.

† Leçons cliniques sur les principaux Phénomènes de l'Hypnotisme dans leurs Rapports avec la Pathologie mentale. Par J. Luys. Paris: Georges Carré, Editeur, 58 Rue St. André-des-Arts, 1890.

From the social point of view these new states of instantaneous loss of consciousness into which hypnotic or merely fascinated subjects may be made to pass deserve to be considered with lively interest. As I shall have to explain to you later, the individual in these novel conditions no longer belongs to himself; he is surrendered, an inert being, to the enterprise of those who surround him. At one moment, in the passive stage in this condition of lethargy or of catalepsy, he is absolutely defenseless and exposed to any criminal attempt on the part of those who surround him. He can be poisoned and mutilated. Where a woman is concerned, she may be violated and even infected with syphilis, of which I have recently observed a painful example in my practice. She may become a mother without any trace existing of a criminal assault, and without the patient having the smallest recollection of what has passed after she has awakened. Sometimes, in the active condition, the state of lucid somnambulism, and even in the condition of simple fascination, the subject may be exposed to the influence of suggestions of the most varied kind on the part of the person directing his actions. He may be induced to become a homicide, an incendiary, or suicide, and all these impulses deposited in his brain during sleep become forces stored up silently, which will burst forth at a given moment with the precision, accuracy of performance, and automatic impetuosity of acts performed by the really insane. Gentlemen, bear this well in mind; all these acts, all these phenomena unconsciously accomplished are no mere vague apprehensions and vain suppositions; they are real facts which you may meet with this very day in ordinary life. They are apt to develop, and to appear around you and before you in the most inexplicable manner.

Of course the question will be asked, Are the practical uses or the applications of the artificial sleep (the induction of which is the residuum of this psychological puddle) of such value as to counterbalance its evils? As to its surgical uses, which at first sight are the most obvious, Luys himself says:

At the first appearance of hypnotism, when Braid had shown that hypnotized subjects are insensitive to external stimuli, surgeons conceived the idea of using this method for the performance of certain operations. In fact, some among them had the opportunity of testing it with a certain amount of advantage. But since the wonderful discovery of chloroform (and, it might be added, of local anæsthesia by cocaine, the vaporization of ether, etc.) these attempts, so far as concern surgical anæsthesia, have been justly abandoned. At the present time the application of hypnotism to surgical therapeutics is of absolutely no account, since it concerns only a small number of persons—namely, the class of hypnotizable subjects.*

In the domain of medicine M. Luys is naturally more hopeful and more affirmative; but obviously inspires less confidence than his calmer and more critical colleagues at the Salpêtrière, who have abstained from following him in these new developments and who regard them with disfavor and distrust. To me, the so-called medical cures by hypnotism seem to rank in precisely the same class as those of the faith-curer.

* Applications thérapeutiques de l'Hypnotisme. Par le Dr. J. Luys. Paris: Imprimerie F. Lève, 17 Rue Cassette, 1889.

The hypnotic *endormeur* is very well able to explain the miracles of faith-cure and pilgrimage by the light of his own experience. They result, as he explains accurately, from the reaction of mind on body, the effects of imagination, of self-suggestion, or of suggestion from without. Those who benefit by them are especially the fervent and the enthusiastic, the vividly imaginative, the mentally dependent, and, above all, the hysterical—male or female. But clearly, the faith-curer may retort upon the hypnotizer that they are brothers in their therapeutic results, if not in their faith and philosophy. The one can work about the same percentage of cures as the other—and no more: and the intervening apparatus, whether of magnets, mirrors, or of grottoes, only serve to affect the imagination, and to supply "the external stimulus" which is necessary.

To this category belong also the long series of thousands of asserted cures of people who wear what they are pleased to call magnetic belts, or who used to wear magnetic rings, who were cured by the Perkins tractors, whether of wood or of iron—they are the prey of the quacks of all ages and countries.

One essential part is, however, I conceive, that no new faculty was ever yet developed in any of these hypnotics. The frauds of clairvoyance, of spirit perceptions, of gifts of language, of slate-writing, of spirit-writing, of far-sight, of "communication across space," of "transfer of mental impressions," of the development of any new sense or ghost of a new sense, remain now as ever, for the most part, demonstrable frauds or perhaps in a few cases self-deceptions. At the Salpêtrière, at Nancy, wherever the facts have been impartially and critically examined, this has been the result. It results once more now from my test of the subjects of the Charité and the École Polytechnique. It will, I suppose, be too much to expect that we shall hear no more of the "New Mesmerism," but it will be easy for any one thus experimentally to reduce it to its true dimensions.

Finally, as to the practical question, which has perhaps a greater interest for the sociologist than any which have suggested themselves up to this point. Since the hypnotist faith-curer of the hospital ward and the priestly faith-curer of the grotto are in truth utilizing the same human elements and employing cognate resources, although masked by a different outward garb, we may ask ourselves which can approximate to the greater successes and which does the least harm.

So far as I can see, the balance is in favor of the faith-curer of the chapel and the grotto. The results at least are proportionately as numerous, and they are more rapid. Numerically there are, I incline to think, more faith-cures at Lourdes than there are "suggestion-cures" in the Salpêtrière or the Charité. So far as

hypnotism is good for anything as a curative agent, its sphere is limited, by Charcot, Féré, Babinski, and all the most trustworthy medical observers of Paris, to the relief of functional disorder and symptoms in hysterical patients. The Nancy school put their pretensions higher; but any one who will analyze for himself, or who will study Babinski's able analysis of the Nancy reputed cases of cure, will easily satisfy himself that such claims are not valid. As to the use of "suggestion" as an anæsthetic substitute of chloroform for operation purposes, that "sugges ion" dates back now beyond the ages of Esdaile and of Elliotson. It has been given up and fallen into disuse because of its unreliability and limited application. It is now sagely proposed to use hypnotism for "tooth-drawing," for the treatment of drunkards and of school children. The proposition is self-condemned. To enable a dentist to draw a tooth painlessly, the average man or woman is, by a series of sittings, to be reduced to the state of a trained automaton; but happily only a very small proportion can be. The criminal courts have seen enough of hypnotic dentists. As to the "suggestion" cure of drunkards or the "suggestion" treatment of backward or naughty children, systematic and intelligent suggestion is what every clergyman, every doctor, and every schoolmaster tries to carry out in such cases and often does successfully—and in a better form than the degrading shape of hypnotism. Moreover, for drunkenness it is, so far as my inquiries go, a failure.

If a striking effect is to be produced by an apparatus destined powerfully to affect the imagination, the faith-curer of the grotto has this advantage over the *endormeur* of the platform or the hospital. He does not intrude his own personality and train his patient to subject his mental *ego* to that of his "operator." The "mesmerizer" seeks to dominate his subject; he weakens the will power, which it is desirable to strengthen. He aims at becoming the master of a slave. I do not need to emphasize the dangers of this practice. I need not even relate them. I have briefly quoted the warnings of one of its apostles, or at least so much of them as it is seemly here to relate.

The faith-curer of the grotto strengthens the weaker individuality. He plays upon the spring of self-suggestion. The patient is told to believe that he will be cured, to wish it fervently, and he shall be cured. So far as he is cured, he returns perhaps a better and a stronger man, and his cure is quite as real and likely to be quite as lasting as if he had become the puppet of a hypnotizer. The experiments of the Salpêtrière have served to enable us to analyze more clearly the nature of faith-cures generally, and they have thrown a ray of light on a series of phenomena of human automatism never before studied so clearly or

philosophically, but they have added practically little, if anything, to our curative resources. It is hardly to be set down to their discredit that they have incidentally favored the reign of the platform hypnotizer or the vagaries of the subjects at La Charité; that is their misfortune rather than their fault, but it is a grave misfortune. But the intervention of authority might at the present, in respect to the latter, cut short these absurdities and put an end to some social mischiefs which have fastened on to them and hang to their skirts. Thus much as to the sociological question. To the student of "psychological phenomena" it has a great interest to note how successive functions may be separately abolished as the brain is partially set to sleep, and in what exaggerated forms the remaining activities may be brought upon the stage when restraining self-consciousness is stilled. The vulgar, too, may find an ignoble amusement in the antics of these drinkers of petroleum and vinegar, in the semi-idiotic postures and proceedings of the hypnotized manikin, as they do in a *fantocchini* show or a puppet play. But against such philosophic satisfactions and vulgar amusements must be set the avowed and the unconfessed mischiefs, and who can doubt that these outbalance any good result which can be discerned?—*Nineteenth Century.*

[*Concluded.*]

## SOME REMARKABLE INSECTS.

By WILLIAM J. FOX.

THE great majority of persons have no idea of the numerous and singular forms of insects. They are all called "bugs" by most people, yet not one tenth of their number are really bugs. These latter are classed by themselves and are called *Hemiptera.* Beetles are not bugs, being totally different things, and form what are known as the *Coleoptera,* which means sheath-wing, because of the two large plates on the back that cover the true wings, which consist of thin membrane. These covers are called elytra. The butterflies and moths form another one of these orders, being called *Lepidoptera,* or scale-wing, on account of the tiny scales with which the wings are covered. No doubt many of the readers of this article have noticed the powdery substance which comes off a butterfly or moth on handling it. These are the scales, and, should any reader possess a microscope and place the wing or part of one under it, I think he will be repaid for his trouble. The "dragon flies" and "devil's needles" form the order *Neuroptera,* which means vein-winged. So it is with the flies and the

bees, wasps, and ants, the flies being called *Diptera*, i. e., two-winged, and the bees, wasps, and ants, *Hymenoptera*, or membrane-wing. It will probably be said by some that ants have no wings; but this is only the case with what are called neuters or workers, the males and females being provided with wings. The total number of different kinds of insects that are known at present is over two hundred thousand, of which beetles alone number one hundred and twenty thousand — this being about twice as many as all the other known animals together. It is estimated that the actual number of different kinds of insects in the world is over one million.

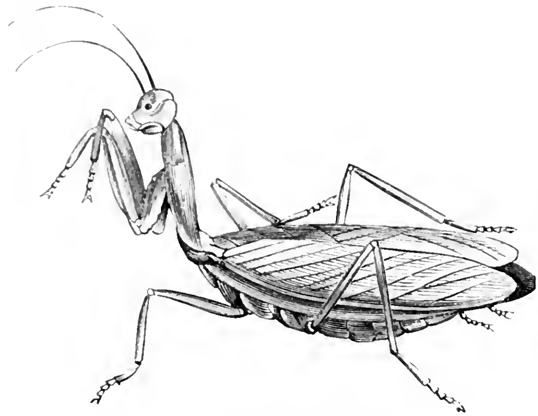

Fig. 1.—Praying Mantis.

The *Orthoptera*, to which grasshoppers and roaches belong, present many oddities; foremost among them, in the United States, is the mantis or "praying mantis." It is very common throughout the South. It will be seen that the fore legs are armed

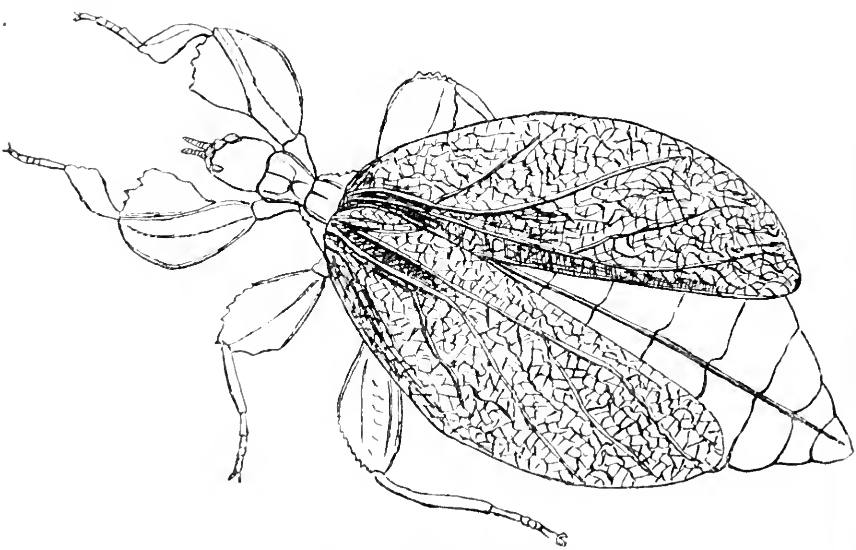

Fig. 2.—The Walking Leaf.

with strong spines or teeth, used for securely holding any insect that may fall into its clutches. I have seen this insect leisurely devouring flies held between these legs. From it there was no chance of escape. A specimen observed in captivity washed itself in the same manner as a cat, rubbing its head and face with its fore legs. In South America a species of mantis is said to seize and devour small birds.

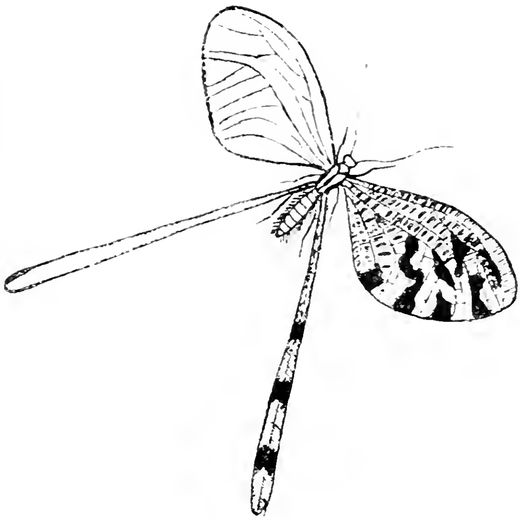

FIG. 3.—NEMOPTERA COA.

Another strange orthopter is known as the "walking stick," which so closely resembles the stems of plants upon which it lives that it is very difficult to find them. One species (*Diapheromera femorata*) is abundant in the Middle States. This species is green when the foliage upon which it lives is of that color, but when this changes in the autumn the color of the walking stick changes also. It is said to do great injury to oak and other trees.

In the East Indies is found an insect that greatly resembles a leaf, both in form and color, as will be seen by the figure on page 528. It is very appropriately called the "walking leaf," and is known to scientists as *Phyllium siccifolium*. There are about a dozen species of these insects known, all of which are from the Oriental regions.

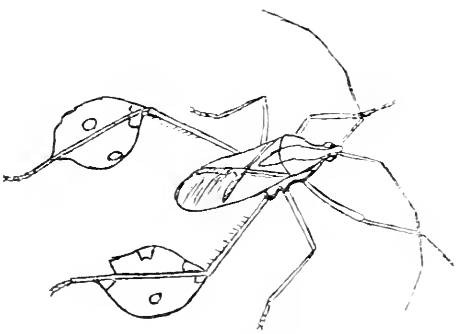

FIG. 4.—DIACTOR BILINEATUS.

In southern Europe there is found a peculiar insect that belongs to the *Neuroptera*, the same order as do the "dragon flies," "devil's needles," "snake doctors," etc. The scientific name of this insect is *Nemoptera coa*. It will be seen that the first pairs of wings are very broad, but this is not the peculiar part of it; it is the hind pair that are remarkable, being extremely long and narrow and a little broader toward the end, which gives them the appearance

of paddles. There is nothing more in this group of insects that is very striking.

We will now take up the *Hemiptera*, of which the well-known bedbug is an example. One species from tropical America (the *Diactor bilineatus*) has very slender legs, except the tibiæ of the hind pair, these being broadly expanded. What use these expansions are to this insect is not known.

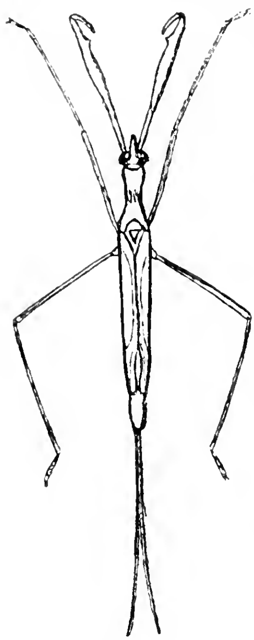

Fig. 5.—Ranatra fusca.

Another singular species, one that is found throughout most parts of the United States, namely, *Ranatra fusca*, inhabits ponds and other streams. It is known to destroy the eggs of fishes and to attack young fish. It is when they attack fish that their stout fore legs come into play, being used for grasping and holding any unfortunate fish that should fall within their reach. It will be seen how well adapted these legs are for the purpose.

Among the beetles, or *Coleoptera*, there are many curious forms, of which I will only mention a few of the most prominent. *Acrocinus longimanus*, the "long-armed" beetle, as it is called, has the fore legs greatly elongated, being twice as long as the body and about three times as long as either of the other legs. It inhabits tropical America, where it is said to be quite abundant.

The giants among insects belong to the genus *Dynastes*, and to several allied genera. Of *Dynastes*, one (*D. hercules*) found in

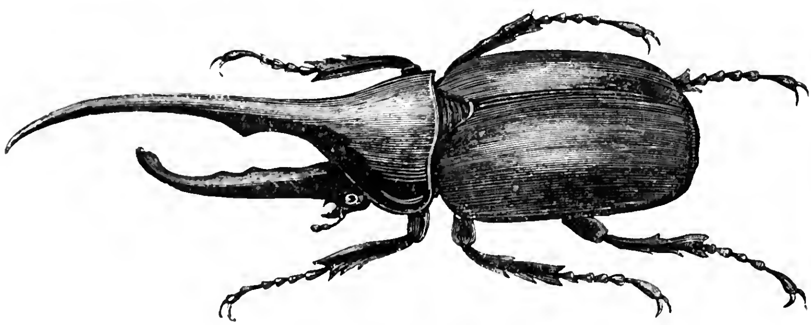

Fig. 6.—Dynastes hercules.

Africa attains a length of six inches, and is remarkable, not only for its great size, but for the long, curved horn which projects out from the thorax; beneath this horn there is another much

shorter one, which projects from the head, being armed with several huge teeth. Insects of the male sex only are provided with these immense horns, those of the opposite sex being quite a different-looking beetle, being without any trace of these projections. There is a species that inhabits the southern United States that also belongs to this genus, but it is much smaller, being about two and a half inches long.

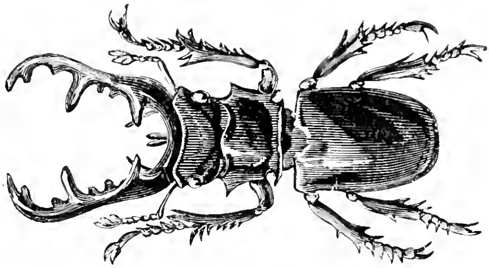

Fig. 7.—Stag Beetle.

The "stag beetle" of Europe is another strange form, the mandibles of the male being greatly enlarged. From the shape and size of the jaws one would suppose that this insect is predaceous, but it is on the contrary a vegetable feeder, using its great jaws to wound the plant, which causes the sap or juices to flow, upon which it feeds. The jaws of the females are in no way conspicuous. There is also a closely allied species found in the United States, but it is a smaller insect. Many other curious forms are found among the beetles, but they are too many to mention.

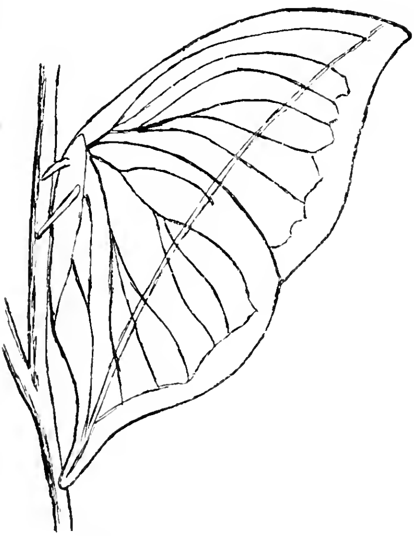

Fig. 8.—Dead-leaf Butterfly.

The *Lepidoptera*, or butterflies and moths, have a few odd forms among them. One of the most interesting is what is known as the "dead-leaf" butterfly, found in the Malay Archipelago. The under side of this butterfly greatly resembles a dead or dried leaf, so much so that it is next to an impossibility to detect it when it alights among withered bushes. Wallace, in his book The Malay Archipelago, says of this insect: "Its upper surface is of a rich purple, variously tinged with ash color, and across the fore wings there is a broad bar of deep orange, so that when on the wing it is very conspicuous. . . . I often tried to capture it, without success, for, after flying a short distance, it would enter a bush among dead or dried leaves, and, however carefully I crept up to the spot, I could never discover it until it would suddenly

start out again and then disappear in a similar place. At length I was fortunate enough to see the exact spot where the butterfly settled, and, though I lost sight of it for some time, I at length discovered that it was close before my eyes, but that in its position of repose it so resembled a dead leaf attached to a twig as almost certainly to deceive the eye when gazing full upon it." In tropical America there are a number of species that have wings so transparent that it is possible to read small print through them. Among the moths the "death's head" of Europe is remarkable for having on the top of the thorax the figure of a skull and crossbones. It is an object of great terror to the ignorant classes, and it is said "has more than once thrown a whole province into consternation, the people thinking it was some infranatural being sent upon the earth as a messenger of pestilence and woe."

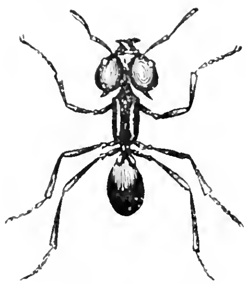
Fig. 9.—Umbrella Ant.

The *Hymenoptera*, which include the bees, wasps, and ants, contain a number of interesting forms, especially among the ants. The "umbrella ant" of Brazil has a tremendous head in proportion to its body, as will be seen by the figure. It has received the name of the umbrella-ant because of its habit of cutting out round pieces of the leaves of orange and coffee trees, which it carries by its jaws in an upright position, so that it looks as though it were utilizing its burden to keep off the heat of the sun.

The "driver ant" of Africa, the sting of which is compared to the thrust of a red-hot needle, is another interesting subject. These ants are totally blind, and, when an army of them gets on the march, all animal life in their path gets into activity, for woe to any living creature of small and even large size that should fall into their power! They also enter houses, driving the inhabitants from them, but on the return of the latter, after the ants have left, they find their place of abode cleared of all vermin; rats, mice, and all other pests of the house are destroyed by these scavengers. The largest serpents, if gorged, will fall a victim to these remorseless creatures. They have been known, when a stream interrupts their journey, to actually link themselves together and form a floating bridge, over which the

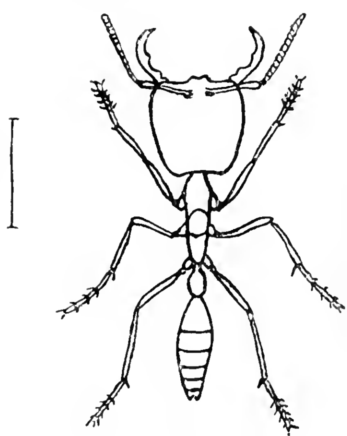
Fig. 10.—Driver Ant.

rest of the army passes. When a stream is too rapid for such a bridge, they form a suspension bridge by hanging from a friendly branch, and when wafted across by a breeze, they firmly anchor on the opposite shore, thus allowing the rest to cross in safety, and swing over themselves when the others have all crossed.

## THE MATERIAL VIEW OF LIFE AND ITS RELATION TO THE SPIRITUAL.

By Prof. GRAHAM LUSK,
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WE live in a material age. Old beliefs are being supplanted by what seem to be new truths. The student finds on every hand vast volumes of learning bequeathed to him by those who have labored before him; and he who plunges deeply into this onward-rushing tide of material truths is often startled to find there an undertow sucking away the spiritual foundation. Skeptics, in scorn of latter-day religion, refer to the middle ages as the ages of faith. Christians, half dismayed, ask themselves, Is mankind to be swallowed up in the abyss of materialism?

It is the purpose of this paper to discuss life from a strictly material standpoint, and afterward to show that belief in the material interpretation does not cut one off from belief in the spiritual.

My own ideas have been largely influenced by German thought. Those who have had the privilege of listening to the lectures of Prof. Carl Voit in Munich will recognize in this paper many traces of his teaching. Through him I received instruction in the material view of life.

The idea of the world held by Aristotle was that all things were made up of certain elementary matter, qualified by four properties—hot, cold, wet, and dry. Matter, with the properties cold and dry, was earth; with cold and wet, water; with hot and wet, air; and with hot and dry, fire. Different bodies varied from each other as they contained different proportions of the properties. These properties could be driven off from matter—that is to say, were separable from matter. Thus, the alchemists of the middle ages thought if they could drive a certain property out of mercury, or put a new one into it, clearly they would produce gold.

In like manner these same principles came into use for the explanation of life. During life there was a property present which departed at death—a living principle, a "vital force."

Galen, who was born at Troy, and who died at Rome A. D. 200,

applied the learning of Aristotle to his practice of medicine. Man, he said, is but matter containing certain properties. If these properties be in correct proportion, well and good; but if the balance be upset, sickness results. The therapeutics of Galen consisted, therefore, in restoring the lost property. If the patient had a chill, he put him in a warm bath; if he had a fever, he put him in a cold bath.

Van Helmont, whose work belongs chiefly to the first half of the seventeenth century, tells us of the existence of an Archæus, and in this theory he was supported by Paracelsus. The Archæus was a spirit which had its abode in the stomach of man. If the Archæus were well nourished, he was pleased and happy; but if anything disagreeable reached him, he made his displeasure painfully evident, and if something were not done to appease his anger, he betook himself off, and the man was dead.

Our present views are entirely different. Properties are not separable from matter. Properties are inherent in matter. Upon this knowledge our modern opinions are based. We have spoken of a belief that life depended on a property—a "vital force." A "force" may be defined as something that can not be explained. The laws of gravitation stand as Newton left them, but what the force of gravitation is no man can say. Hence, the expression "vital force" was but a confession of ignorance. No, there is no such thing as a "vital force." There are in living Nature and in the inanimate world the same materials, ruled in both cases by the same natural chemical and physical laws, only the conditions in living Nature are different from the conditions in the inanimate, and consequently the phenomena observed are likewise different.

Let us now look at some of the discoveries which have caused us to accept this material view of life.

Harvey, in 1616, first taught the true doctrine regarding the circulation of the blood, and compared the heart to a pump.

Scheiner, a Jesuit priest, declared the action of the eye to be like that of a *camera obscura*, the lens of the eye acting to form a picture on a background.

Keppler developed the theory of spectacles.

Borelli explained how the mechanism of breathing was due to the elasticity of the lungs and to the muscles acting as power upon levers—the ribs.

Lavoisier showed that animal heat was due to the decomposition of higher chemical compounds of the food eaten, just as the heat of the candle is produced by the combustion of its constituents.

All these facts are easily seen to be but followings after Nature's laws. Chemistry brings many proofs confirming the doc-

trine that there is no fundamental difference whether of properties or of governing laws between the animate and the inaminate. The chemist turns starch into sugar in the laboratory; the intestines do the same.

We find at the beginning of this century a theory supported by Lavoisier which declared that, to form an organic compound, life was necessary. The organic compounds had properties essentially different from the inorganic or mineral, and were formed under different influences—under the influence of a "vital force."

The greatest blow to this theory was the discovery by Wöhler, in 1828, that he could make urea in the laboratory. Here, then, was a characteristic animal substance, which was actually formed in the laboratory without the intervention of any "vital force" whatever. Since Wöhler's discovery an overwhelming number of similar bodies have been formed in like manner. Sugar may be made from its elements—carbon, hydrogen, and oxygen. There is little doubt that at some future time the method of making all the materials of any organization will be known to the chemist.

It has been said that organic materials are more easily decomposable than inorganic; but albumen, if dried, will keep for years, whereas silver iodide on the sensitive photographic plate is changed by light in the hundred-thousandth part of a second.

Hence, it is not difference in materials that can distinguish the organized from the unorganized. Indeed, every organization consists in major part of water, which is inorganic, and every organization must contain salts. In both organic and inorganic we find crystals; white of egg has already been crystallized. In fact, there is no boundary to be drawn. Over the organic and inorganic rule the same natural laws. The distinction is merely conventional.

The difference between the organized and the unorganized does not lie in the materials represented, only in the *arrangement* of the materials. The element of life is the minute cell. All life in the organization is dependent upon the activity of the cells. I have said that the conditions in the organized were different from those in the unorganized. The cell furnishes the conditions for life. Now, the arrangement of the materials in the cell is different from that in unorganized matter. In the piece of copper or crystal of sugar the smallest particles are everywhere the same. In the living organized cell the smallest particles are everywhere different. Such arrangement of materials that the conditions for life are present is the so-called protoplasm.

The yeast cell is a microscopic sausage-shaped organization which, under proper conditions, changes sugar into alcohol and carbonic acid. This is a characteristic function. In the same manner the cells in the body have their characteristic functions in decomposing the materials furnished by the blood.

The living cell is made up of organic and inorganic constituents. It contains carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, chlorine, sodium, potassium, calcium, magnesium, fluorine, silicon, and iron. All these are necessary to life. Abstraction of one of these elements means death to the organization.

We have traced life down to the cell. The lowest forms of life, both animal and vegetable, are single cells, and from these single cells, according to the theory of evolution, all life has been produced. But how about the origin of the first cell? We do not believe in spontaneous generation—that is to say, no case of the spontaneous generation of life from its elements has ever been recorded by man. But we may reason thus: All substances, even the simplest, require certain conditions for their production. The conditions required to produce a living cell must of necessity be extremely complicated. We do not know of such conditions, but for the sake of argument we may imagine that at some former period of the world's history conditions may have existed favorable to the production of the first life.

When we seek to define life we uncover a difficult problem. But who can define the steam engine? There is no satisfactory definition for either. We can merely say that life is the result of the activity of the cells.

It follows from this that it is useless to seek for a seat of life. The seat of life has been placed in the blood, but this is the nourishing fluid; in the heart, which is merely the pump for the blood; in the *medulla oblongata*, but this contains the nervous center for breathing. There is no such thing as a seat of life. Life is the result of the activity of all the organs of the body.

To every living thing there at last must come an end, and in this fact of death the advocates of a "vital force" saw the necessity for their theory. But this is explicable in a material manner. In life, as in death, decompositions are continually going on. These decompositions are in kind not different, only during life the products of decomposition are removed, and at death these products remain in the body and poison the individual cells—that is, so alter them that their conditions no longer fulfill the requirements of life.

The uneducated Indian when first shown a watch thought that it was alive; we, on the contrary, have come to regard the living organization as a machine. Upon this basis alone can physiology endure as a science, and physiology is, as the reader knows, nothing but the study of the phenomena of life.

I have endeavored, up to this point, to give an exposition of the material view of life as complete as the most exacting materialist could desire. Many men reach this point and refuse to see further; they make materialism their creed, and cast religion to

the winds. Now, is this rational? Is it impossible for the scientific mind to conceive of the existence of the soul? Certainly not.

When we seek for explanation of intellectual activity we find two views advanced—one, the purely material view that all thought comes uncontrolled from the decomposition of matter, from motion in the molecules; the other, the spiritual view that mental activity is under the domination of a soul. Under no circumstances can the soul be in a position to produce something out of nothing; it must rather, in the production of thought, utilize the materials furnished to the brain by the blood. The existence of the soul has never been scientifically proved; on the other hand, no material thinker can pretend that the purely material view explains the phenomena of intellectual activity. Let us see, therefore, if we can not employ some reasoning in support of the spiritual view, which declares the existence of the soul.

Matter is divided into ponderable and imponderable—ponderable, that which can be weighed; imponderable, that which can not be weighed. We place a body under the bell jar of an air pump and exhaust the air; all the ponderable air is thus removed. There still remains the imponderable ether. On this ether light-waves travel, and the object in the *vacuum* therefore continues visible. Here, then, is a something in the *vacuum* which is invisible, imponderable, and yet whose existence is scientifically acknowledged as pervading all space. This ether is set in motion by the vibrating object we have under consideration; this motion is communicated to the nerve endings on the background of the eye, travels thence along the nerve, and produces in the visual sensorium of the brain the sensation of what we call light. The existence of this ether has never been scientifically proved, but it gives an explanation to something otherwise inexplicable.

A man dies; the spirit passes from him; the flesh is left. The man has not lost in weight; the spirit is imponderable. Now, as there is a connection between the luminiferous ether and the nerve endings for sight, why can not there be a connection between the spirit and the countless mass of cells and fibers where is what we call the intellect? And, likewise, may there not be a spiritual ether surrounding us, a medium through which impulses may come to the spirit from on high, and from the spirit be transmitted to the intellect? Such influences come to us strongly at times, as at the communion-table. The existence of the soul, I have said, has not been scientifically proved, but it is the explanation of something otherwise inexplicable.

We gain our experience of the world through our senses. Man is born with intellect, and through the senses that intellect is trained. The newborn baby possesses already some knowledge of touch acquired before birth, and this knowledge he afterward

rapidly expands by constantly feeling his body over and over, as if in exploration of unknown territory. Later he acquires the faculties of hearing and seeing, and likewise of tasting and smelling. Now, these senses, five in number, are they which train the intellect. They are all very imperfect. Sight: but the greater part of the solar *spectrum* is invisible—that is to say, more rays which come to us from the sun are invisible than those which our eye can see. Hearing: but there are sounds so low and sounds so high that they are inaudible. Taste and smell: very imperfect. Touch: but there are millions of particles of dust to the square inch of the hand which we can not feel. Yet, even with these imperfect means of education, many men have reached the conclusion satisfactory to themselves that they are clever; but the wisest man knows nothing in comparison with perfect wisdom.

The whole of the known universe consists of matter in motion. All sensation, everything we know of the outside world, comes to us through motion. The motion sets up a movement in the nerve ending, on the skin, on the retina of the eye, or wherever the proper ending capable of receiving the particular motion may be situated. This motion is carried from the nerve ending along the nerve to the special central organ of the brain where it is interpreted. Light, sound, touch, taste, and smell are the only forms of motion we are capable of appreciating, because for each of these forms of motion we have a special apparatus which can receive, transmit, and interpret. There are other forms of motion which we can not appreciate—magnetism, for example—and this simply because we have no nervous mechanism which responds to that kind of motion. In like manner there can exist around us forces in infinite variety of which we have absolutely no knowledge whatsoever.

Now, is it not conceivable that, in the spirit after its severance from the flesh, our present imperfect senses may become perfect, and the influence of other now unthought-of sensations become possible? What the new sensations and the new life will be are unknown, unknowable. A man is born blind. He attains through touch, hearing, and the minor senses a certain amount of knowledge of the outside world, but his ideas of what really is must of necessity be absolutely and entirely different from our own. The operation for cataract is performed; the man can see, and is shown a familiar object—a book for example; but he can not say what it is; he must touch it first. His ideas of things undergo an immediate and radical change. So it will be at death with our ideas of heaven. The blind spirit, released from the influence of the flesh, passes into perfect understanding of infinite knowledge.

To my mind, the material view of life should have no terrors to believers in religion.

# SEALING IN THE ANTARCTIC.

By a Member of the Recent British Whaling Expedition.

A LAPSE of nine months has brought back the Antarctic Whaling Expedition. It will be remembered that in September last four ships—the Balæna, the Diana, the Active, and the Polar Star—set out from Dundee to try their fortunes in the south polar seas, since of late the Davis Strait and Greenland fishing has not met with entire success. The expedition was to try to obtain a whale which Sir James Ross described as "greatly resembling and by some said to be identical to the Greenland whale," and was to restrict its researches to that region visited by Ross in his third voyage to the Antarctic in the summer 1842–'43. At the request of the Royal Geographical Society and of the Royal Meteorological Society, it was arranged that the medical officers accompanying the expedition should, under the guidance of the masters and with the assistance of the other officers, make such scientific observations as were compatible with an expedition so purely commercial in character. With this understanding these two societies gave a grant of instruments which Mr. Leigh Smith and others liberally supplemented with other scientific outfit. Naturally, therefore, among scientific circles a certain amount of chance scientific work is being looked for. The expedition has added considerably to our knowledge of the meteorology of the southern end of the globe and has noted geographical and other features. But, on account of the overwhelming commercialism of the expedition, opportunities, which might have been taken advantage of, have been allowed to pass.

Owing greatly to the hurried departure of the expedition, much setting in order of material and seeking out of information regarding these scarcely known parts employed a considerable amount of time on the passage out, and systematic meteorological observations were commenced from the outset; tow netting and other collecting was reserved for latitudes south of 40° south, and for the homeward voyage, for it was deemed unwise to occupy space and make use of preservatives which might be required for material obtained in high southern latitudes. Nevertheless, on the passage out, it was thought advisable on a few occasions to take a cast of the net. For the whole outward passage, with the exception of a few days in the southeast trades, the ships were baffled by head winds, for nearly three weeks we wished our native shores more distant, and for fifteen days the Roaring Forties racked us with southwest gales. We experienced heavy squally weather, with frequent lightning and heavy rain. The *maximum* temperature of the air was 83° Fahr. on the 23d and

24th of October, in 3° 56′ north, 25° 15′ 15″ west, and 2° 33′ north, 25° 37′ west respectively, and from the 17th to 22d, 25th, and 31st October and the 2d November the thermometer registered 80·8° to 83°.

On the 8th of December the rising sun dispersed a dense fog and revealed the rugged shores of West Falkland, the first land we had seen for three months, and in its likeness recalling the last glimpses we had of Cape Wrath. By noon we had dropped anchor, and during the next few days, while the ship was being stocked with a supply of fresh meat and water, the surgeons of the vessels were able to make one or two short excursions. These excursions, however, had to be extremely brief, for not knowing when the ships would depart it was necessary to remain in sight of them the whole time. A few plants, stones, and insects were hastily gathered together, and several birds shot. Among the latter were the notable steamer duck and the upland goose. A striking feature of the Falkland Islands is the great absence of trees; the camp, as the open country is termed, is clothed with a short scrub called diddle-dee (*Empetrum rubrum*), growing upon and indeed chiefly forming the enormous peat-beds that this country is so rich in; the largest bush native to the country is the gigantic woolly ragweed, which grows to a height of three or four feet; but there are few flowering plants. The gorse or furze has been introduced and seems to thrive well, but a few trees that have been planted about Stanley present a meager appearance. Mosses and lichens abound everywhere and many of the lichens are very beautiful. Besides the above-mentioned, one must note the ever-famous balsam bogs and tussock grass, and the enormous banks of kelp that fringe the coast, the stems of which vary in length from five to forty feet. Among birds, the penguins and albatross must not be forgotten. Insects are rare. The famous wolf-like fox is almost extinct; Darwin's prophecy is coming true—the wild horses and cattle now no longer roam the plains, their place having been taken by the more remunerative sheep. The fur-seal is still found, but so eagerly have they been hunted that their numbers have been greatly reduced. A solitary lizard and a few insects almost complete the list of animals found in these islands. One must ever remember the world-renowned streams of stones and the characteristic quartz rocks cutting their way through the quilt of peat. But Darwin, Hooker, and others have so ably pictured the natural features of the Falkland Islands that it would be out of place to describe them again after so short a visit. There is a great change, however, since Darwin's time—he found it a settlement of thieves and murderers, now it is a peaceful British colony, for, after a disputed possession of the islands by Britain, Spain, France, and Buenos Ayres, Britain finally took

possession of them in 1833 and formed a colony which is now ruled by a governor and is also the see of a colonial bishopric. The colony at first was far from prosperous, but since 1885 the revenue has considerably exceeded the expenditure. During our stay at Port Stanley his Excellency the Governor honored our ships with a visit, as well as several of the residents of the settlement, and we are greatly indebted to his Excellency and Lady Goldsworthy for the hospitality they showed us.

Early on Sunday morning we took leave of the Falkland Islands and steered for the ice, and on December 16th, in latitude 59° 18′ south, longitude 51° 01′ west, met the first iceberg—it was of enormous dimensions and tabular: a second was sighted in the evening. The same day we met myriads of cape pigeons, also many blue petrel and molly-hawks. The sea was literally swarming with whales of the finner kind, and their resounding blasts could be seen on all sides. So numerous were the cape pigeons, and so eager were they for any scraps thrown over the ship's side, that any number of them could have been caught with small hand-nets only large enough to contain one at a time, and many of them were thus captured by the crew. That night it became overcast and rainy, and at midnight a fog came on; fogs continued, with shorter intervals of clearer weather, during which intervals we were able to push southward for the next few days, and the weather was squally, the wind being from northeast, north, and northwest, varying in force from a light air to a moderate gale. After six days of this inhospitable weather, the wind on the afternoon of December 22d shifted more to the south, and the fog quickly lifted. On December 17th we met with the first seal—it was one of the larger kind which Ross described, nearly twelve feet long, having a bearlike head, with formidable canine teeth; it was curled up and asleep, and it was drifting by as we lay in the fog. It was promptly shot and brought aboard by a boat lowered away for the purpose. Several pieces of drift ice were seen on the 17th of December, and several bergs, nearly all flat-topped. On the evening of the 22d we first met with a flock of ten or a dozen of the beautiful sheathbill, and on the morning of the 23d sighted and passed the group of Danger Islets, lying off the extreme west of Joinville Land, which was lying behind them. The sea in the evening became of an olive-brown color, and we met with the snowy petrel, two indications which Ross noticed of the main pack being at hand. On the following evening three of the Dundee ships made fast to a very large floe. On Christmas day observations were taken, and it was found that we were a little south of Ross's position on New-Year's eve of the summer of 1842–'43—viz., latitude 64° 13′ south, longitude 55° 52′ west, and where he says "great numbers of the largest-sized black

whales were lying upon the water in all directions; their enormous breadth quite astonished us. The color of the sea was a dirty brown, probably occasioned by minute ferruginous infusoria, which were found in the greenish-colored mud that was brought up by the deep-sea clams from a depth of two hundred and seven fathoms." The sea was as Ross describes it, and soundings were obtained at 8 P. M. in one hundred and ninety-four fathoms, but no black whale did we see, only whales with fins on their backs, but be it noted that several grampuses or killers were seen from the masthead, and they are noted persecutors of the black whale in the north.

Up to this time several seals had been obtained—the large seal, the white antarctic seal, and the sea leopard; also four different kinds of penguins, including a few of the large emperor penguins, and one seen in the neighborhood of the Falklands. Besides these, we had met with a good many sheathbills, several snowy petrel, the blue petrel, the giant petrel, the stormy petrel, the cape pigeon, a gray gull, and later with many terns and a few great petrel. Christmas eve and Christmas day, when we were fast to the floe, will long be remembered by the members of the expedition. There was a perfect calm; the sky, except at the horizon, had a dense canopy of cumulus rolls, which rested on the summits of the western hills, and when the sun was just below the horizon the soft grays and blues of the clouds and the spotless whiteness of the ice as it floated in the black and glossy sea were tinted with the most delicate of colors—rich purples and rosy hues, blues, and greens, passing into translucent yellows. At midnight the solitude of the vacant deck was grand and impressive, and perhaps more so since we had, for well-nigh a week, been drifting among bergs with dense fog and very squally weather. Nothing broke the calm peacefulness; now a flock of the beautiful sheathbills would hover round the vessel, fanning the limpid air with their wings of creamy whiteness, and over yonder was a foul carrion bird with outstretched wings feeding upon the gory corpse of a slaughtered seal. All was in such unison, all in such perfect harmony; but it was a passing charm. Soon we had to think of more prosaic things, and reluctantly we turned our thoughts to the cargo we were to seek. It was with the produce of seals that we were destined to fill our ship, and till February 17th we were literally up to the neck in blood. All the sails are stowed; the captain sits in the crow's nest from early morning till late in the evening; the two engineers, relieving one another, take charge of the engines; the cook or the steward is on the lookout on deck or on the bridge; and the doctor takes the helm, unless he can manage to get away in the boats, in which case some other noncombatant has to take his place—all the rest

are away after plunder. Now a full boat is making its way to the ship. We steam toward her. As we near, the engines are stopped and she glides alongside. The cook or the steward rushes from the lookout, the doctor from the wheel, one working the steam winch and the other unswitching the skins, while the boat's crew swallow a hasty meal. The boat being unloaded, they are off again for another fill. The greatest rivalry exists between the boats' crews, each endeavoring to get the greatest load for the day. Another boat is seen approaching, and away we go again, dodging this piece of ice, charging that piece with our sturdy bows, boring away where the ice lies closely packed, rounding this berg, and on to the next until we reach the boat, which is down to the gunwale in the water, with its crew cautious, plying their oars as they lie crouched upon their bloody load. So it goes on from day to day: hay is made while the sun shines, and the pile of skins and blubber rises high upon the ship's deck. Then comes a gale of wind, accompanied by fog, sleet, and snow, and we lay to under the lee of a stream of ice or a berg. The deck becomes busy with life, the blubber is "made off" and put into the tanks, and the skins are salted. When the gale is over, at the end of two or three days, the next few days of calm weather are again taken advantage of in the boats. Thus the periods of gales and calms which alternate in this part of the world come in quite conveniently for sealing, the produce obtained in the calm weather being "made off" during the gales. We never experienced much swell, being sheltered by the land, our work lying only a little east of Erebus and Terror Gulf. With "all hands and the cook" so incessantly occupied in the calm weather, all scientific observations were at a standstill, but in the evening, and sometimes during the night, a few chance readings could be obtained, and during gales fairly copious meteorological notes were obtained.

The seals are very foolish beasts. The present generation have never seen man, and they survey him open-mouthed and fearful, during which process they are laid low with club or bullet. Sometimes they are so lazy with sleep that a man may dig them in the ribs with the muzzle of his gun, and, wondering what is disturbing their slumbers, they raise their head, which quickly falls pierced with a bullet. There may only be one seal on a piece of ice, which is usually the case with the larger kind; but the smaller kinds lie in half-dozens and tens, and as many as forty-seven were seen on one piece. Seldom do any escape—one cartridge means one seal. Besides the three seals mentioned we came across a fourth, a large kind with a small head, small fore flippers, very thickly blubbered, and a more woolly skin. The last day of our sealing we were among a great host of the largest

big-headed seals, and as we were returning to our ship they were moaning loudly. This was said to be a sign that they were about to start upon a long journey, but was it not rather a sigh of relief when they saw their slaughterers' craft run up her bunting and announce to all that she was a full ship, that her thirst for blood was quenched? Penguins are the strangest creatures ever seen. They are supremely funny as they quack and strut about with their padded feet over the snow, or, coming to a slope, glide swiftly downward toboggan-fashion upon their breasts. If one lands on the piece of ice they are resting upon, they approach fearlessly with a threatening "Quack! quack!" For their inquisitiveness they, too, often received the handle of the club, for it was soon found that their flesh greatly resembled that of the hare, and upon them we had many a tasty and substantial meal. The emperor penguin is very difficult to kill; he will live after his skull has been most hopelessly smashed; the best way to put an end to them is to pith them. Six of us one day set out to capture one alive, and so strong was the bird that five with difficulty kept their hold, and, after he was bound with strong cords and nautical knots, he flapped his flippers and released himself.

The drift ice we came across was not heavier than that of Davis Strait, but the bergs were of very different character, nearly all flat, not pinnacled and not so lofty as those of the north, but of huge length, frequently being four miles in length, sometimes eight or ten, and one we met with was no less than thirty miles long, taking us six hours to steam from end to end at five knots. These are valuable when one can lie under their lee in a gale, but, when they are to leeward, form a dangerous lee shore, and more especially so for sailing ships.

One of the doctors had the good fortune to effect a landing in Erebus and Terror Gulf, obtaining specimens of plants, eggs, and rocks.

The lowest temperature recorded in the ice was +21·1° Fahr., or nearly 11° of frost; this was on the 17th of February, but usually it was about +32° Fahr., more or less.

On the 17th of February we steered for the Falklands, and thence homeward. Our homeward passage has been one continued spell of fine weather; the winds were mostly light, and too frequently head winds. The highest temperature recorded was 84·4° Fahr., in latitude 1° 10′ north, longitude 25° 21′ west, on the 13th of April; for the previous eight days 80° Fahr. and over are recorded, and also on the 3d of April, as well as five days following the 13th of April. From the ice to some degrees north of the line floats were thrown over to record the currents, and the townet was over frequently.

While in the ice we met the Jason, a Norwegian bark with

auxiliary steam power, under the command of Captain Larsen, and with her we kept company most of the time. He reached the ice about a month earlier than ourselves, and surveyed the pack edge as far as 30° west. Captain Larsen also landed on the South Orkneys and on Cockburn Island, where he obtained several geological specimens.—*London Times.*

## HONEY AND HONEY PLANTS.

By Dr. G. G. GROFF.

THE popular idea is that all flowers alike produce honey, and that bees pass from blossom to blossom indiscriminately collecting the sweet fluid. This, however, like many other popular notions, is incorrect. By no means all flowers yield honey, and most of them yield it very scantily. Indeed, those plants visited by honeybees which yield any considerable amount above that consumed by the bees from day to day are, in any one section of the country, limited to a very small number, and usually not more than one, or at most two, of these plants are in blossom at one time. There are, however, a good many flowers that yield some honey, yet are for various reasons not visited by honeybees, among which we may name the honeysuckle (visited, however, sometimes for the pollen), and plants of the buttercup family. In some cases the honeybees can not reach the honey, in others it is probably not palatable to them.

It is also true that there is a great difference in the amount of honey produced in different years by the same species of plants. Sometimes there seems to be almost no honey at all in white clover, one of the best honey plants in our Northern States, while at other times honey is in the blossoms for a few days, and then it suddenly disappears, or in other seasons there is honey so long as blossoms of clover are to be found. The secretion of honey does not depend upon the season being moist, for usually the honey "flow" is greatest in dry seasons. There does seem to be some connection between the amount of honey produced and the character of the soil upon which the plants grow. Thus clover growing on clayey ground seems to yield more honey than that growing on hillsides where there is but little clay. The same is true of other plants. Often there is honey in one district and none in another not far distant.

The plants which yield "surplus" honey in the North Atlantic States in ordinary seasons are the red and black raspberries, the white clover, the basswood, and the buckwheat. Some other plants may yield small additional quantities, but are hardly of

practical importance. There are, however, some early spring flowers giving honey which is useful in stimulating brood-rearing in the hives, without which there is no hope of any surplus. We will first name some of these plants.

The practical bee-keeper knows that his hopes of obtaining honey all depend upon his having his hives full of bees when the "flow" comes. Brood is produced in quantity only when some honey can be obtained from flowers then in bloom. Hence the importance to the apiarist of the early blooming flowers.

The willows of several species, and the silver and red maples, blossom in March and April, depending upon the season. They yield both honey and pollen, and whenever the days are warm enough the bees constantly visit them. If one is about his apiary on warm days in March and April, he will notice the bees coming in with pollen even at times when no flowers have been observed. At such times they doubtless have found blossoms on some warm bank and are making good use of them. The poplar trees also bloom in April, a little later than the willows. Reference is here had to the true aspen poplars, not the tulip poplar. The dandelion and strawberry blossoms are much visited by bees. Later, about the first of May, we have the sugar maple and the blossoms of the fruit trees—the peach, cherry, plum, apple, pear, quince, etc. These all yield honey and pollen. During some warm and early springs, in very strong colonies, honey may possibly be stored which has been gathered from the fruit blossoms, but, as our seasons average, the honey from our fruit trees goes altogether to stimulate brood-rearing. The locust trees (both the honey and the black locust) blossom after the fruit trees and before the white clover. Surplus is seldom stored from these blossoms, though they are good honey producers. Their honey goes to produce more brood or to feed the colony until the clover comes. We next consider plants which produce surplus honey. These for the Atlantic States are few in number.

Of the plants which produce surplus honey the white clover is first named. This plant grows spontaneously throughout the whole region. In the well-cultivated sections it is almost the only honey-producing plant left on which the apiarist can any longer depend. It begins to blossom in June and continues on into July. The honey from this plant is the whitest and finest produced. It is entirely free from any peculiar or offensive taste or odor, and is a general favorite.

In the more northern States the red raspberry commences to blossom a little later than the white clover. This is a valuable honey plant of which bee-keepers in the South are deprived. This honey is considered by many to be fully equal to that of the white clover. In July the basswood blossoms. This tree yields

a great amount of honey, but unfortunately there are no longer many trees to furnish blossoms and nectar. This honey is darker than that from clover, and has also a peculiar odor, which is unpleasant to many persons.

The last plant of value as a honey producer is buckwheat, which begins to blossom in August and continues until frost. The honey from buckwheat is dark and has a taste of its own which is not offensive. This honey is very rich, and a taste for it is speedily acquired. The cultivation of this plant is becoming, year by year, more restricted, and is now confined to the newer and more mountainous sections.

Those regions where the land is all under cultivation have only the white clover to depend upon for honey, unless there are a few basswood trees along the streams, while in the mountainous areas will be found clover, basswood, raspberries, and buckwheat It takes but a moment, then, to decide where one could best hope to succeed in bee-keeping.

We place among the plants which produce a small or variable amount of honey the mint and figwort families; also the asters and golden rods. Of the first family, the mints, we have the horehound, the sage, bergamot, the catnip, and the motherwort, all producing considerable honey. Of this group, the most remarkable is the motherwort (*Leonurus cardiaca*), which is constantly visited by bees while it is in blossom. The supply of honey is limited only by the number of plants, which at present in most places is small. It has been suggested that this plant be cultivated for the honey it yields. It is now a rather unsightly weed. The figwort (*Scrophularia nodosa*) is an excellent honey plant. It has a square stem, and exteriorly a good deal resembles the mints. It is a worthless weed except for its honey-producing flowers. It is not very abundant. The wild mustard, the teasel, the boneset, the wild sunflowers, the Spanish needles, and the snapdragons, as also the smartweeds, produce some honey, though in most places the total is of little value. In Michigan, Prof. A. J. Cooke holds the golden-rods in high esteem as honey producers. In Pennsylvania the writer can not find that they are of any value at all. On newly cleared land the sumac springs up, and it is held by some to be a valuable source of honey, and that considerable amounts are some years collected from it.

The tulip poplar, popularly called "poplar," also produces honey in its beautiful large blossoms, but the tree is too scarce to be of much value to the bee-keeper. The blossoms of the blackberry, like their near relatives, the raspberries, are honey producers. The milkweeds are also secreters of honey. Curiously, the pollen of these plants often sticks to the heads of the bees and disables them so much that they perish. Prof. A. J. Cooke

says that at times the blossoms of the Indian corn yield both honey and pollen to the bees, but we think to no great extent. We have never observed the bees working on these blossoms.

The laurel (*Kalmia*) yields honey which is poisonous. Generally the bees do not work on these blossoms, but in some localities they do, and we frequently read of persons poisoned by honey which probably comes from this plant. It is thought that the poisoning of the Greek soldiers under Xenophon was by honey from this family of plants in this case from rhododendrons.

The plant lice (aphides) which infest many plants secrete a sweetish fluid of which bees, ants, and other insects are very fond. In seasons when real nectar is scarce or altogether lacking, bees will collect and store this material, which is generally known as honeydew or manna. There is, however, another variety of honeydew which seems to be secreted by the leaves of plants and is gathered by the bees. This material is hardly fit for human food, nor is it for bees either, and it is doubtless a principal cause of winter loss of colonies, for it produces in the bees a diarrhœa from which they perish if the winter is one of continuous cold, so that they can not take an occasional cleansing flight. Cider, juices of grapes, and all other sweet fluids are collected and stored by bees in seasons of scarcity. The general bad effects of all these are the same as of the honeydew—they produce intestinal disorders of which the bees die.

The profitable cultivation of plants, otherwise useless, for honey alone has never yet been demonstrated, and the low price of sugar will probably preclude any such efforts in the near future. Honey will remain a luxury, and as such will be produced in favorable locations—that is, on poor soil, where the honey plants grow naturally, and where the land can be utilized for nothing else. However, in the planting of shade trees it would be well to plant those which will produce honey as well as shade.

The effort is made by practical bee-keepers to find some plant, like the buckwheat, which may make a useful farm crop and at the same time produce honey. Many think alsike clover will do this. Prof. Cooke thus speaks of it: "Alsike or Swedish clover (*Trifolium hybridum*) seems to resemble both the red and the white clover. It is a stronger grower than the white, and has a whitish blossom tinged with pink. This forms excellent pasture and hay for cattle, sheep, etc., and may well be sown by the apiarist. It will often pay apiarists to furnish neighbor farmers with seed as an inducement to grow this *par excellent* honey plant. Like white clover, it blooms all through June into July. It should be sown early in spring with timothy, five or six pounds to the acre, in the same manner that clover is sown."

# SKETCH OF PAOLO MANTEGAZZA.

By Prof. FREDERICK STARR.

As a nation we know far too little of what is being accomplished in the world outside. We do in some degree keep track of the work of our English brothers, and occasionally some French or German worker compels our recognition. But there are many intelligent readers who do not know that Italy is to-day a veritable center of scientific work. Yet such is the case, and in such sciences as astronomy, zoölogy, and botany great progress is making there. Nor are they at all behind in anthropology; and the man who leads in Italian anthropology is Paolo Mantegazza.

No doubt to many American readers his Physiognomy and Expression, lately put into an English dress, is the only work of Mantegazza's known. It is a remarkable book—not only on account of its matter, which is of great value, but also on account of its style. There is scarcely a scientific book in any language that so plainly reflects its author, in his individual and ethnic characteristics. To read it is to gain a wonderful insight into the Italian mind and into the Italian mode of thought and expression.

Paolo Mantegazza was born at Monza, near Milan, Italy, on October 31, 1831. His mother was a remarkable woman—Laura Solera—well known for philanthropy and patriotism. No small part of the force of character, the strength of purpose, and the clearness which Mantegazza shows in his work seems to be inherited from this woman. She established the first *crèche* and founded the first professional school for women in Italy. During the wars of 1848 and 1859 she cared for the wounded soldiers. There appears to have been an unusual love between this mother and son, and Mantegazza refers to her at times in his writings. He always deferred much to her opinion; and in 1883, when some question had arisen as to the propriety of his famous book upon the Physiology of Love, the author submitted the book to her for judgment. Her letter of approval is presented in full in the introductory chapter of the work, and ends thus: "When I shall have the happiness of having you near me, I shall point out to you the passages which most please me. Meantime receive the enthusiastic greetings of your affectionate mama."

Mantegazza studied medicine in the Universities of Pisa and Pavia. Having become a physician, he spent several months in Paris and then journeyed over a large part of Europe. At the age of nineteen years he published a memoir upon Spontaneous Generation, and was appointed Acting Professor of Chemistry in the Technical School at Milan. The first of the remarkable series of anthropological works which has rendered his name famous—

The Physiology of Pleasure—appeared when he was only twenty-two years of age. It has been published and republished, translated and retranslated, and, although forty years have passed since its appearance, it is still issued in new editions in Italy. In 1854 Dr. Mantegazza removed to South America, and for four years practiced medicine at Buenos Ayres and Entrerios in the Argentine Republic and also in Paraguay. Returning to Italy in 1858, he practiced medicine and surgery in the military hospital during the war of 1859. In 1860 he secured, by competitive examination, the chair of General Pathology at the University of Pavia, and established in connection with that institution the first laboratory in experimental pathology, from which such eminent physiologists as Bizzazzero and Golgi have gone forth. In 1870 he removed to Florence to take the first chair of Anthropology. Here he has remained, constantly busying himself in every way that could extend the science to which he is so entirely devoted. Here he has founded the National Museum of Anthropology and Ethnology, the Italian Society of Anthropology, and the journal Archivio per l'Antropologia e la Etnologia. What Broca was to Paris and to France, Mantegazza is to Italy. The parallel is a strong one, for not only is Mantegazza, like Broca, a leader in anthropological science, but he is a leader of the most liberal portion of the workers in that field.

Of all sciences anthropology is the one which most keeps a man in touch with men and affairs. Every one knows the slap that the German emperor gave to Virchow recently at Berlin. The occasion was the birthday celebration of the two great scientists—Helmholtz the physicist, and Virchow the anthropologist. His Majesty congratulated Helmholtz upon having devoted himself so closely to his science that he had never meddled in political matters. It is easy for the physicist to do so. But how can a man who studies mankind hold himself aloof from human interests? Mantegazza has long been in public life. In 1845 he was sent from Monza as representative and was re-elected four times; while in 1876 he was elected senator of the kingdom of Italy. He has never been a political leader, but has always been clearly identified with the Liberal party.

Mantegazza's writings are exceedingly numerous and varied. He has written anthropological memoirs, works on medicine, volumes of travel, monographs upon special races, biographical studies, and romances. Among his more important anthropological works are Physiology of Pleasure, Physiology of Pain, Physiology of Love, Physiology of Hate, Love in Humanity, Hygiene of Love, and Physiognomy and Expression. All these have been translated into the leading languages of Europe and have exerted an immense influence. One or other of his books have

been translated into fourteen distinct tongues. His three works on Love—Physiology, Hygiene, and Ethnology—have sold by thousands in Germany and France. Perhaps the only one of his more important works which has appeared in America is his Fisionomia e Mimica—Physiognomy and Expression. This has been issued in at least two forms within the last three years and has sold largely. Although we have already referred to it briefly, it deserves especial mention. It is an excellent example of Mantegazza's nervous, impetuous style. Nothing that has been written elsewhere upon expression can approach it. Every great emotion of mankind is taken up, and the form of expression by which it makes itself known is exhaustively analyzed. The subject itself is so attractive and the treatment so interesting that the book—unlike most scientific books—will bear reading and re-reading for pleasure. No one but an Italian could have written it. Expression is at its best where the blood is hot and vigorous, and where people feel as they live; in such a country as Italy, and among a people like the Italians, only could such a study be so well made.

Analysis is the word which describes all of Mantegazza's work. Analysis shows itself in his writings; it shows itself also in his museum, one of the most remarkable in the world. It is the National Museum of Anthropology and Ethnology. Fair in ethnography, good in general anthropology, it is remarkable in somatology, and unique in psychology. Who but the writer of Fisionomia e Mimica could analyze so cleverly the material in Physical Anthropology? Who but so good an analyst could fail so utterly in combining the material into a symmetrical whole? Mantegazza's Museum of Psychological Anthropology is his latest hobby. Here he plans to show by material objects the operations of the mind—the development of religiosity, the expression of love, of fear, of cruelty—of every emotion of our kind.

As an editor Mantegazza has done vast service. His Archivio per l'Antropologia e la Etnologia is a standard journal in the science, but of course reaches only a select circle of fellow-workers. The Hygienic Almanacs, however, which have appeared under his direction for a quarter of a century, in editions of many thousands, have not only done much to improve sanitary conditions among his own people, but in their German and Hebrew translations have reached thousands outside of the land of his birth. While speaking of this service, we may mention that Mantegazza's contributions to medicine have been neither few nor unimportant. It was he who introduced coca into Europe, and his monograph upon this valuable plant was "crowned."

Mantegazza is to visit America in September, and it is to be hoped that he may meet that hearty kindness from us which he has always extended to American men of science in Italy.

# EDITOR'S TABLE.

### *A GREAT WORK CONCLUDED.*

ALTHOUGH there still lacks a volume of the ten originally planned by Mr. Herbert Spencer for the exposition of his Synthetic Philosophy, the publication of the tenth volume of the series (the second and concluding one of the Principles of Ethics) gives very legitimate occasion for rejoicing to all who, like ourselves, regarding the Synthetic Philosophy as the most important contribution yet made to an understanding of the laws of the organic world in their special bearing on human life, consider the portion dealing with ethics as the most important of the whole work. Mr. Spencer, we understand, having thus crowned the edifice of his philosophy, will proceed at once to complete it by writing the one volume still outstanding—namely, the third of the Principles of Sociology, or the eighth of the series.

It is, indeed, a long road on which the distinguished author looks back when his thoughts revert to the publication in the year 1855 of the first edition of his Principles of Psychology. For forty years very nearly has he been toiling over one of the most arduous tasks that any man ever set himself; and with what perseverance, unflagging resolution, and high spirit he has carried that task through its successive stages the world at large has been a witness. "You who write," says Horace, "consider well and long what your shoulders will bear and what they will not bear." It has seemed at different times as if Mr. Spencer had taken on his shoulders a burden too great for his physical strength. His health, as every one is aware, has for years together been such as greatly to limit his power of work, and at times to condemn him to complete inactivity. Still, he has persevered, making the most of all opportunities, and to-day his great undertaking is so nearly accomplished that its entire completion may be reasonably counted on. At one time this was more than the author himself hoped for, and more, we have little doubt, than any will less resolute than his own would have realized. We believe, and take pleasure in believing, that Mr. Spencer has been largely sustained in his severe and exhausting labors by the thought that he was working for his generation and for subsequent generations. His philosophy is meant for guidance. He has aimed at making men understand the kind of world they live in and the kind of laws with which they have to reckon. Theology has in general placed its most impressive sanctions in a supernatural order of things and in a future state of existence. Mr. Spencer contents himself with showing the springs, conditions, and consequences of human action in the present order of things, leaving those who are so disposed to find necessary admonition therein, and those who are otherwise minded to take their own course, whatever it may be. The question has often been raised whether philosophy can constrain men to right conduct. The answer we should be disposed to give is, that a true philosophy, one resting on the facts and laws of life, if duly blended with early education, would powerfully incline the young to virtue. It does not profess to be a stimulus for jaded appetites or exhausted moral vitality, and can not be counted upon as an agent for sudden conversions; but, given as the daily bread of life, it can nourish and strengthen the moral and intellectual natures of men.

"Give strong drink to him that is ready to perish;" but do not cast any reflections upon bread because, at such a moment, it might rather choke than aid the sufferer.

The volume which Mr. Spencer has just given to the world is one of great value and interest. In our book notices will be found a summary of its contents: but we desire here to add our commendation of it as an eminently practical treatise on the two important themes of Justice and Beneficence. The portion dealing with Justice was published separately two years ago, and was noticed in these columns at the time. Much of the matter which it contains is, however, of such urgent importance in the present day that we hope the publication of the complete volume will have the effect of calling attention anew to its analysis of rights and its trenchant discussion of the nature and functions of the state. The portions dealing with Beneficence under the two heads of Negative and Positive bring out in a striking manner the large element of sympathy in the writer's disposition. Careless critics have heretofore been in the habit of asserting that the evolution philosophy, as expounded by Mr. Spencer, enjoined pure selfishness. There was quite sufficient in earlier portions of Mr. Spencer's writings—particularly in the Data of Ethics, published in 1879—to disprove this assertion; but not even a careless critic could make it after reading, however cursorily, the volume before us. Here is a noble passage from the chapter on Succor to the Ill-used and the Endangered: "Doubtless it is well for humanity at large to maintain the tradition of heroism. One whose altruistic promptings are so strong that he loses his own life in an almost hopeless effort to save another's life, affords an example of nobility which in a measure redeems the innumerable cruelties, brutalities, and meannesses prevailing among men, and serves to keep alive hope of a higher humanity hereafter. The good done in occasionally putting egoism to the blush may be counted as a set-off against the loss of one whose altruistic nature should have been transmitted."

Mr. Spencer has himself anticipated the criticism that much of what he says in regard to beneficence will not seem to have any very clear connection with the doctrine of evolution; and so far he professes himself disappointed in the outcome of the work. We do not feel called upon to share in his disappointment. The doctrine of evolution has served in the earlier volumes to interpret the world for us, to enable us to understand our environment, and know both how it has come to be what it is, and how we have come to be what we are. That it should also serve as a guide through the complexities of human action is more than we ever expected. Knowing ourselves and our environment, the conduct we ought to pursue as being likely to result in the greatest amount of happiness to ourselves and others may be arrived at by reflection and experience. Mr. Spencer, in the last two sections of the present volume, analyzes the principal situations in which individuals are liable to find themselves, and shows in an instructive manner the conduct, negative and positive, appropriate to each. We do not see how much fault can be found with any of his conclusions. To us it appears that he lays down many of the most important principles of correct and useful social behavior, and that his treatise as a whole, but particularly the sections dealing with beneficence, would make the best kind of household reading for a large class of families. Philosophy here puts on a homely garb and walks hand in hand with the wisdom that every day's experience teaches. Until Philosophy does this, her work is not finished. Mr. Spencer's last words seem to us his best.

## LITERARY NOTICES.

The Principles of Ethics. By Herbert Spencer. Vol. II. New York: D. Appleton & Co.

Of the three portions into which Mr. Spencer's new volume is divided, the first was published separately two years ago, under the title of Justice, and dealt with those things which human beings may claim as rights. The two latter portions now appear for the first time, and deal respectively with Negative Beneficence and Positive Beneficence. Mr. Spencer recognizes the sentiment of justice no less than the sentiment of beneficence as altruistic, the first implying a voluntary concession of the claims of others to free activity and the products or results of free activity, and the second a disposition to aid others in obtaining the objects of their legitimate desires. In the preface to the present volume the author acknowledges that the new parts fall short of his expectations. He has not been able to affiliate them to the extent that he hoped to the doctrine of evolution. "Most of the conclusions," he says, "drawn empirically, are such as right feelings enlightened by cultivated intelligence have already sufficed to establish." It is in ethics very much the same as in purely scientific theory. Specially gifted individuals will, by their deeper intuitions, anticipate the results of later experience or reasoning, and will thus succeed in formulating principles in advance of their definitive establishment. That the principal conclusions of ethics should not stand in very direct relation to the theory of evolution is not, however, surprising, inasmuch as these conclusions would in all probability be the same even if the history of human development had been materially different in its earlier stages from what it has been. What the evolutionist philosopher has to show, as it seems to us, is that there is no conflict between the principles of ethics and any of the deductions from the doctrine of evolution. If that doctrine were fundamentally unsound, the proof of its unsoundness might lie in the region of ethics, but the attentive reader of Mr. Spencer's last volume will at least be convinced that this is not so.

The warrant for beneficence as distinguished from justice lies in the fact that like justice it tends, if properly regulated, to promote life and happiness; but being in excess of justice, and therefore a more or less indefinite thing, the need for its proper regulation is very obvious. Mr. Spencer, as we have seen, deals with it under the two heads of Negative and Positive. A man is negatively beneficent if he abstains from actions which might promote his private interests, because he sees that such abstinence will promote the interests of another, his own being already sufficiently secured. Some of the examples which Mr. Spencer gives under this head may seem a little trite; but there are different ways of being familiar with a principle or rule of action, as John Stuart Mill once remarked. It is one thing to assent to a truth in a general way, and another to accept it with a full perception of all that it either presupposes or involves. Some of Mr. Spencer's counsels under the head of Negative Beneficence seem to resolve themselves into the familiar formula, "Live and let live"; but how many carry out that formula as fully as they should? It is an easy thing to repeat such a motto as "Live and let live"; but when it comes to foregoing a business advantage clearly within reach, in order that another individual may not unduly or undeservedly suffer, the motto is very apt to go to the wall, which, as every one knows, is a favorite place for mottoes. The question, therefore, is not whether the specific counsels given by Mr. Spencer have previously been given by others—Mr. Spencer admits that to a large extent they have been—but whether they are severally sound, and whether they are in harmony with his general system of philosophy. A motto or maxim floating in a kind of disengaged way in the moral atmosphere of the age does not carry at all the same authority as a rule of action forming part of a well-established system of thought; and the hope may therefore be indulged that an attentive reading of Mr. Spencer's new volume will lead many to see that maxims of conduct which heretofore they have felt themselves free to act upon or set aside according to the humor of the moment have a sanction which can not rightly be disregarded. Under the several heads of Restraints on Free Competition, Restraints on Free Contract, Restraints on Undeserved Payments, Restraints on Dis-

plays of Ability, Restraints on Blame, and Restraints on Praise, Mr. Spencer makes many excellent remarks bearing on every-day conduct. We regard these chapters, indeed, as moral discourses of the highest value, and commend them to the earnest attention of all whose duty it is to give moral instruction to old or young. Many a Christian minister might, we are convinced, infuse new life into his teaching by simply assimilating the contents of this volume and thus acquiring a fresh sense of the truth, the authority, and the interdependence of moral precepts which have heretofore had the warrant only of dogma or of sentiment.

To illustrate the class of matters with which Mr. Spencer here deals, we may quote the following from the chapter on Restraints on Displays of Ability:

"In nearly all cases the intrusion of personal feeling makes controversy of small value for its ostensible purpose—the establishment of truth. Desire for the *éclat* which victory brings often causes a mercilessness and a dishonesty which hinder the arrival at right conclusions. Negative beneficence here conduces to public benefit while it mitigates private injury. Usually the evidence may be marshaled, and a valid argument set forth, without discrediting an opponent in too conspicuous a manner. Small slips of statement and reasoning, which do not affect the general issue, may be generously passed over. A due negative beneficence will respect an antagonist's *amour propre;* save, perhaps, in cases where his dishonesty and his consequent endeavor to obscure the truth demand exposure. Lack of right feeling in this sphere has disastrous public effects. It needs but to glance around at the courses of political and of theological controversy to see how extreme are the perversions of men's beliefs caused by absence of that sympathetic interpretation which negative beneficence enjoins."

If any have heretofore supposed that the evolution philosophy leaves but a very restricted field, if any, for the exercise of practical benevolence, the volume before us should suffice to banish the idea. There is a wide scope, as Mr. Spencer shows, for negative beneficence, or self-restraint in the interest of weaker individuals, and there is also a wide scope for the exercise of positive beneficence or the active assistance to those less favorably circumstanced than ourselves. The one condition to be kept in view is that our assistance be not of a nature to cause subsequently more serious trouble or suffering than it alleviates in the present. The subdivisions of Positive Beneficence treated by Mr. Spencer are Marital Beneficence, Parental Beneficence, Filial Beneficence, Aiding the Sick and Injured, Succor to the Ill-used and the Endangered, Pecuniary Aid to Relatives and Friends, Relief of the Poor, Social Beneficence, and Political Beneficence. Here and there in reading these chapters, as also indeed in the section on Negative Beneficence, we find the line of demarcation between Beneficence and Justice a little shadowy. Both, of course, are subdivisions of Ethical Conduct in general, and that the two aspects, which Mr. Spencer for convenience of exposition tries to keep separate, should now and then seem to merge in a higher unity is not surprising. The man who has it in his power to be just or unjust, and who decides, against his own immediate interest, in favor of justice, must in general be moved by a sentiment of beneficence; and, on the other hand, the man who exercises a wise, rational, and restrained beneficence will probably regard his own conduct as, on a broad view of the matter, scarcely going beyond the limits of justice.

It might possibly puzzle some fairly informed readers to understand in advance what Mr. Spencer means by "political beneficence": the virtue is certainly one not much understood in political circles. Let the following sentence give the key to the puzzle: "Under a political *régime* like that into which we have grown, taking a share in political life is the duty of every citizen; and not to do so is at once short-sighted, ungrateful, and mean: short-sighted, because abstention, if general, must bring decay of any good institutions which exist; ungrateful, because to leave uncared for these good institutions which patriotic ancestors established is to ignore our indebtedness to them; mean, because to benefit by such institutions and devolve the maintenance and improvement of them entirely upon others implies a readiness to receive an advantage and give nothing in return." A passage which has special application to this country is the following: "In

America, where party organization is more developed than here, whoever declines to surrender his convictions and follow in the mob which is led by a 'boss' to the polls, is labeled with the contemptuous name of 'Mugwump,' and is condemned as pharisaic and of an unsocial disposition. In the 'land of liberty' it has become a political crime to act on your own judgment."

Mr. Spencer has not for a long time given us a book from which a greater number of striking and helpful quotations could be made than from this; but our notice has already exceeded the limits usual in these columns, and we close by renewing the expression of our hope that the admirably practical teachings which the book contains may be widely diffused and bring forth fruit abundantly.

Darwin et ses Précurseurs Français. Étude sur le Transformisme (Darwin and his French Precursors. A Study of Transformism). By A. de Quatrefages. Paris: Félix Alcan. Pp. 294. Price, 6 francs.

The purpose of this work, as defined by the author, is, looking at the subject from the point of view of natural science, to determine exactly what is Darwin's, find what is true in it as well as what can not be accepted of it, and to try and assign to each its value and the deductions which are drawn from it. Reduced to the terms of a descent of all animal and vegetable species by successive transformations from three or four original types and probably from a primitive archetype, it is found to offer little wholly new. Darwin himself has given a list of twenty-six naturalists of various nationalities who had published views more or less similar to his before him. Of these, M. Quatrefages has compared the expressions of the French naturalists, including Benoist de Maillet (or Telliamed), Robinet, Buffon, Lamarck, Étienne and Isidore Geoffroy-Saint-Hilaire, Bory de Saint-Vincent, and M. Charles Naudin. Suggestions of these ideas may be found further back still, even among the alchemists of the middle ages and the Greek sophists; but the question of the formation of species could not present itself to those thinkers with the same significance that it has done with us. Beginning with the seventeenth century, the proposed solutions multiplied rapidly. The author, not appreciating, perhaps, the patience which English philosophers have cultivated in the matter, thinks the process described by the term evolution too slow to account for the changes of species, and prefers transformism, with transformists as the appellation of the advocates of the theory. After the accounts of Darwin's French precursors, a general exposition of Darwinism and a review of its agreement with certain general facts are given; following which the Darwinian system is subjected to a full discussion in eight chapters. As every one knows, M. Quatrefages is not a Darwinian; but differences of opinion concerning heretofore unexplained phenomena, he says, never make him unjust toward eminent men. While he contests their doctrines he desires to render a sincere and cordial homage to their works. In Darwin he admires the almost chivalric good faith which enables him, even when his mind is most preoccupied with his hypotheses, to be still calm enough to see in his own labors reasons and facts that militate in favor of his adversaries and sincerity enough to point them out. "There is a real charm in following such a mind in its excursions." In the preface to a second edition of the work he dwells upon the neutrality of the Darwinian theory as concerns religious questions, and the impartiality with which it is sustained by orthodox and by agnostic supporters, or opposed alike by adversaries of either school.

Extinct Monsters. A Popular Account of some of the Larger Forms of Ancient Animal Life. By the Rev. H. N. Hutchinson. New York: D. Appleton & Co. Pp. 254.

The object of this book is twofold: to describe some of the larger and more monstrous forms of the past, and endeavor by pen and pencil to present them as they were in life; and to illustrate how in animal life the past has grown into the present without the long and abrupt leaps which we are too liable to regard as one of the chief features of the transition. Stress is laid upon the quality of the illustrations. They are still to a certain extent conjectural, but they rest upon larger and more accurate information than any portraits of the giants and dragons of old that have previously appeared. Many

of the former pictures of these creatures were highly sensational; in some of the later ones neither art nor Nature had fair play, and we had to put up with awkward-looking creatures that could not get along at all in life, or with animals in attitudes which later researches have shown were not theirs. Hence our ideas upon these points need to be revised. The discoveries of later years have shown, as Dr. Henry Woodward observes in the preface he furnishes, "that the dicynodon and labyrinthodon, instead of being toadlike in form, were lacertilian or salamander-like reptiles, with elongated bodies and moderately long tails; that the iguanodon did not usually stand upon 'all fours,' but more frequently sat up like some huge kangaroo with short fore limbs." The discoveries of Marsh, Cope, Leidy, and others in America have added vastly to our knowledge of the real structure of these animals. We have now almost complete skeletons and details of the flying membranes of long and short tailed pterodactyles; the archæopteryx and Marsh's hesperornis and ichthyornis have given more definite shape to our knowledge of primitive birds; and the discovery by Prof. Fraas of the outlines of the skin and fins of ichthyosaurus have established the pertinency of the term fish-lizard as applied to it. These and other discoveries have been applied in the text and illustrations of this book; and we have, accordingly, the saurians of the sea and the land, the real dragons and sea-serpents of old, the monsters of America and of India—megatheriums, glyptodons, mastodon, mammoth, giant birds, Irish elk, and Steller's sea cow—represented with a clearer approach to accuracy than ever before, but still subject to correction by future discoveries.

Bible Studies. By Henry Ward Beecher. New York: Ford, Howards, & Hulbert. Pp. 438. Price, $1.50.

This is a volume of lectures on the early Old Testament books which were delivered in Plymouth Church on Sunday evenings in 1878–'79, as part of an unrealized design eventually to cover the whole Old Testament with the course. The lectures were taken down by Mr. T. J. Ellinwood, according to his custom of stenographically reporting all Mr. Beecher's public addresses, and are now published under the editorial supervision of Mr. John R. Howard. The whole force of them, Mr. Howard says, "goes to throw off all the cramping theory of 'inspiration' which makes God responsible for all the evil that was done by the inchoate Hebrew people in his name. Thus the student is left free to follow this master expositor in rediscovering and newly appreciating the wisdom, the goodness, the grand foundation-work of Moses under the divine impulse, which both served to build up the Israelitish nation and has entered into many of the soundest elements of modern civilization. . . . The attentive reader of these Bible studies will lose no living belief in the ancient Scriptures as containing the word of God to men, while he will gain new and larger views of their worth for Christian life to-day—and that not in spite of the new philosophy of growth, but in full harmony with its irresistible advance." Of special interest, as bearing upon the subject in its generality, are the first three lectures, on The Inspiration of the Bible, How to read the Bible, and The Book of Beginnings.

Representative English Literature from Chaucer to Tennyson. Selected and supplemented with Historical Connections and a Map. By Henry S. Pancoast. New York: Henry Holt & Co. Pp. 514. Price, $1.60.

The author's attempt has been to write a book which should answer the needs of those who are beginning to teach the subject according to new methods. The tendency formerly was to study the history of literature without coming into real contact with the literature itself; now, in our anxiety to avoid this error, we are in danger of rushing into the opposite one, and of studying the literature torn from its living historic and human relations. In the present work the attempt is made to put the student in direct contact with some representative masterpieces, without ignoring the study of literature from its historical side. The sketches and selections are therefore presented in the order of their time by sequence, with a distinct historical thread running through the whole. The authors mentioned and quoted are presented in direct connection with the ages and surroundings in which they lived and wrote. The history and the surroundings are described

in four periods—the period of preparation, ending about A. D. 1400, of which Chaucer is the principal representative; the period of Italian influence (The Revival of Learning and the Puritan in Literature), 1400 to 1600, represented by Spenser, Bacon, Milton, the Elizabethans and the Puritans; the period of French influence, 1660 to about 1750, of which Dryden, Addison and the eighteenth century essays, and Pope are the most conspicuous examples: and the modern English period, including the earlier writers of this century and recent writers to Browning and Tennyson. In the appendix are a Literary Map of England, a list of authors to accompany the map, a Chaucer glossary, and an index.

The Naturalist on the River Amazons. By Henry Walter Bates, with a Memoir of the Author by Edward Clodd. New York: D. Appleton & Co. Pp. 395.

We have already, in our biographical sketch of Mr. Bates, borne testimony to the value of his work on the Amazons, and to the value and interest of this book, and now speak of the peculiar features of the present edition. It is a reprint of the original unabridged edition, with a map and illustrations, including a double colored plate of butterflies to illustrate the theory of mimicry. The description of the book in the subtitle as A Record of Adventures, Habits of Animals, Sketches of Brazilian and Indian Life, and Aspects of Nature under the Equator, during Eleven Years of Travel, shows how comprehensive and varied it is. The memoir, by Mr. Edward Clodd, a near personal friend, who had more than an editor's interest in composing the tribute, has been enriched by letters furnished by Sir Joseph Hooker and Mr. Francis Darwin, with letters from Sir Joseph Hooker and the elder Darwin to Mr. Bates.

A Treatise on Public Health and its Applications in Different European Countries. By Albert Palmberg. New York: Macmillan & Co. Pp. 539. Price, $5.

The author is a health officer, and is active in movements in behalf of public health in Finland. The present edition of his work is a translation from the French original, made at his request by Dr. Arthur Newsholme, of Brighton, who has also brought up to date and completed the chapter on England, and summarized the recent legislation. The treatise is based on the practice in different countries. An analysis of the part relating to England will illustrate the plan and scope of the whole. The first chapter gives a general review of the sanitary administration, with accounts of the local government board, local sanitary districts, and local boards of health, duties of the several health officers, statistical tables, and the daily progress in an urban sanitary office. The next chapter comprises a summary of sanitary legislation as embodied in the Public Health Act of 1875—referring to drainage, utilization of sewage, privies and water-closets, sweeping and cleansing of streets, courts, and houses, water supply, common lodging houses, nuisances, offensive trades, etc., through many particulars provided for in the law named and in other sanitary laws. In a third chapter sanitary regulations are described with similar detail. The two following chapters are given to the sanitary conditions, administration, and regulations of London. The account is there extended to include other countries and their principal cities—Scotland and Edinburgh, Belgium and Brussels, Austria and Vienna, Sweden and Stockholm, and Finland and Helsingfors. These extracts are followed by statistics showing the importance of public hygiene. The book is rich in descriptions and illustrations of sanitary appliances modern and practical. The author has confined his accounts to countries whose methods he has seen and studied personally on the spot.

The Philosophy of Individuality. By Antoinette Brown Blackwell. New York: G. P. Putnam's Sons. Pp. 517. Price, $3.

This work or essay is characterized by the author as "a revised, a broadened, a more full attempt at verification of a system of thoughts less matured in the author's former works, Studies in General Science, and the Physical Basis of Immortality." Its position is that "the character of every perception and of every cognition, and of every mental act of all kinds is dependent in definite degrees upon each and all of the co-operating factors, psychical and physical, which together make up the entire process of every act in which the sensibility is consciously concerned. In other words, all change, all action (change and

action include both feeling and motion) is so entirely under the control of definite law that the sequence of every thought is fully determined by its correlatives of all kinds, in the sense that it must obey the associated laws of thought and of things. The mind must perceive objects, must know them, and must reason about them legitimately in true accord with its own mental attitude working in correspondence with the organism and the extra-organic world." We have found nothing in it clearer than this.

An Elementary Manual on Applied Mechanics. By Andrew Jamieson. London: Charles Griffin & Co. 1892. Pp. 268. Price, $1.25.

This manual is intended especially for students beginning the subject, and forms a companion to the author's other elementary manuals on Steam and the Steam Engine and Magnetism and Electricity. The subject is treated under four general divisions, the first being devoted to statics or forces in equilibrium, the second to hydraulics and hydraulic machines, the third to the laws of motion, and the fourth to the properties and strength of materials.

The book consists of twenty-four lectures delivered by Prof. Jamieson, to his students and the method of treatment and the order of arrangement of the subject matter are based upon the author's experience in teaching. In conformity with this, he has placed the consideration of the laws of motion after that of hydraulics and hydraulic machines, as he finds that it is much better for the student to have some knowledge of simple mechanism before trying to understand the abstract laws of motion. Illustrative examples are given in each lecture, and a list of suitable questions at the end.

Practical Electric-light Fitting. By F. C. Allsop. London: Whittaker & Co.; New York: Macmillan & Co. Pp. 275. Price, $1.50.

This handbook should prove of interest and value not only to the practical electric-light fitter, to whom it is primarily addressed, but to the householder using the electric light who desires to take an intelligent interest in the subject as well. The author begins his exposition with a brief but clear statement of the meaning and relation of current, electromotive force, and resistance, which is quite free from technicalities and understandable by any one without previous knowledge of the subject, and then passes to a consideration of the various appliances and details of construction essential to a complete electric-light outfit. Among the subjects considered are systems of central-station supply, switches, cutouts, incandescent and arc lamps and their accessories, electroliers, running of wires, arrangement of circuits in a house, sizes of wires for a given number of lamps, and meters. All these subjects are treated briefly but clearly, so that the ordinary householder can readily understand them. A full statement is given of the rules of the London underwriters, and the work closes with a chapter upon private installations.

Magnetism and Electricity. By Arthur William Poyser, M. A. London and New York: Longmans, Green & Co. 1892. Pp. 382. Price, $1.50.

This very excellent manual is designed for advanced students, and the subject is treated so as to give the student an experimental knowledge, the text being intended to be an aid to the experimental study and not a substitute for it, as is so often the case.

The main experimental facts of the science of magnetism and electricity are set forth by the author, and simple experiments suggested which the student can perform without the use of elaborate apparatus. A chapter is devoted at the close of the book to some of the applications of the principles of the science, in which the telephone, microphone, electric lamps, and the dynamo are briefly described, and a short but instructive account is given of the recent researches of Hertz in proof of the electro-magnetic theory of light of Clerk Maxwell, and those of Tesla with currents of great frequency.

Hereditary Genius. By Francis Galton. London and New York: Macmillan & Co. 1892. Pp. 379. Price, $2.50.

In republishing this inquiry into the question whether natural ability is hereditary, Dr Galton has chosen to leave it in much the same form in which it first appeared more than twenty years ago, as to recast it and incorporate data now accessible would have ininvolved greater labor than he could well

undertake. The inquiry was originally undertaken at a time when it was believed that the individual mind was capable of almost indefinite development, if only it was properly trained and had coupled with it the necessary will power to urge it on. The outcome of the researches was, however, to show that the mental faculties of the individual are as rigorously limited by ancestral conditions as are those of the body. In support of his conclusions Dr. Galton has examined the kinship of a number of men who have attained eminence in various fields of labor, and has shown that the number of relatives who have been above the average are greatly in excess of the number of such relatives that would exist if there were no causal relation. The classes of eminent men passed in review comprise the English judges, statesmen, great commanders, literary men, men of science, poets, musicians, painters, divines, senior classics of Cambridge, oarsmen, and wrestlers. While the range of Dr. Galton's inquiries is necessarily limited, his main position seems to be established and all our later knowledge is in the direction of its support. The important bearing of this research is upon the future of the race, and Dr. Galton therefore discusses the relation of fertility to ability, and sees reason to believe that in the course of evolution the race may attain a level as high above the highest now existing as this is above the lowest at the present time.

Electrical Papers. By Oliver Heaviside. Two volumes. London and New York: Macmillan & Co., 1892. Pp. 560, 587. Price, 30s.

These volumes contain the contributions of the author during the past ten years to the mathematical development of electrical theory. The papers have been contributed to various scientific periodicals without any intention originally of making them the basis of a systematic treatise, but aside from a few miscellaneous ones at the beginning of the first volume they are of sufficient continuity to present the subject in an orderly, logical development. The papers cover the mathematical treatment of the relations between magnetic force and electric current, the energy of the electric current, induction of currents in cores, electro-magnetic induction and its propagation, and electro-magnetic waves. The views of electrical action and the propagation of electric disturbances here worked out are those first propounded by Clerk Maxwell, and which have in the last decade come to be widely accepted by scientific men, and are forming the basis of all further research. Mr. Heaviside's discussions are addressed only to the mathematical physicist, and are quite beyond the lay reader. They have been recognized as of a high order of merit by scientific men, and have taken their place as a valuable contribution to the scientific literature of the subject.

Alternating Currents. By Frederick Bedell, Ph. D., and Albert Cushing Crehore, Ph. D. New York: W. J. Johnston Co.; London: Whittaker & Co. 1893. Pp. 325. Price,

In this work Drs. Bedell and Crehore, of Cornell University, have undertaken to develop the theory of the alternating current in a more complete and logical form than has hitherto been done. The work is mathematical, and appeals only to the scientific student of physics. The authors divide their treatment into two main divisions, in the first of which the problems of an alternating circuit are treated analytically, and in the second graphically. In each mode of treatment the simpler cases of circuits containing resistance and self-induction only, and resistance and capacity only, are first taken up, and then the more complex cases of circuits containing resistance, self-induction and capacity, and resistance and distributed capacity are considered. The solutions obtained are of universal application, though for the sake of clearness the authors give numerous examples of the application of the general formulas. Parts of the work have appeared as separate papers in various scientific periodicals, and have met with very favorable reception from scientific men.

An Atlas of Astronomy. By Sir Robert Stawell Ball. A Series of Seventy-two Plates, with Introduction and Index. New York: D. Appleton & Co. Price, $4.

Having received an invitation to prepare a new astronomical atlas, Prof. Ball undertook the work with the view of supplying an elementary series of maps, such as had been asked for by the readers of his Starland.

The scheme gradually developed, however, so that while suitably supplying the wants of beginners in astronomical study, the atlas has taken on a scope which makes it more widely serviceable. The plates comprise a general star map in twenty sections, a series of twelve monthly star maps, and several other important single maps and groups. The moon is represented in charts of the four quadrants, and there are also telescopic views of the moon of each day's age from the third to the fourteenth. Each of these pictures is furnished with a key and index of names, and it is believed that students of our satellite will find these plates of much service in identifying the various lunar objects. Other plates represent phases and orbits of the planets, solar phenomena, comets, nebulæ, systems of satellites, eclipses, etc. An introduction of fifty-seven pages describes the plates and gives a list of select telescopic objects suitable for observation with small instruments. Another feature of the present work is an index to planets. The identification of these bodies is difficult for a beginner, on account of their shifting positions. The author has removed this difficulty for the next decade by providing a simple method of learning in a few seconds the approximate position of every important planet. It should be noted that the mechanical execution of the volume is of a high grade.

Life and Labor of the People in London. Edited by Charles Booth. Vol. III. Blocks of Buildings, Schools, and Immigration. Vol. IV. The Trades of East London. London and New York: Macmillan & Co. Price, $1.50 each.

These volumes consist of correlated essays on various features of its subject by a number of special writers. They form a uniformly straightforward account, abundantly fortified by statistics, of how the poorer classes of London work and live, and how their children are educated. There is no sentiment and few comments or suggestions in these volumes; they are crowded so full of facts that no room is left for such matter. Compact tables of figures are introduced frequently, and in Volume III colored maps show the proportions of native and foreign-born population in London and in England. The information which the work contains is of the highest value to the sociologist and deeply interesting to any one who wishes to know "how the other half lives" in a great city. The essays are far from dry, in spite of their meatiness. Thus, one of those devoted to model buildings is a sketch of life in buildings, which is notably graphic. In the chapter on the Jewish Community is a vivid account of the progress of a "greener" from the time he enters the Thames on board an immigrant steamer until he is established in a little business, perhaps two or three years later. The accounts of elementary education and of the secondary education of boys and of girls are also very readable. The trades that receive attention in Volume IV are tailoring, bootmaking, dock labor, furniture-making, tobacco-working, silk manufacture, and women's work; there is also a special chapter on Sweating by the editor. A thorough insight is given into the conditions of work in these trades, and some idea of how both male workers and factory girls spend their leisure is also afforded. These volumes are an excellent example of what sort of investigation is necessary as a basis for any intelligent efforts toward bettering the condition of the poor in a large city.

The *Handbook of Emergencies and Common Ailments* of *E. F. Bradford*, M. D., assisted by *Louis Lewis*, M. D. (B. B. Russell, publisher, Boston), is a really valuable work, larger and fuller than most of the books of similar title, but less bulky and diffuse, and therefore more valuable and practical than ordinary books of household medicine. The author's purpose in preparing it was to present to non-professional readers directions for the diagnosis and treatment of the class of cases described in the title. The author's plan has been to treat the subjects more fully and extensively than is done in the numerous handbooks already in circulation, and to describe in sufficient detail the latest remedies and methods of treatment, or such as are available and easily understood. The object has been kept in view, too, besides pointing out specific remedies for different ailments, to discuss and explain some of the general principles upon which a sensible practice of medicine is founded. The book is divided into five parts. Part I presents some general introductory remarks on symp-

toms and the signs of disease and of death, and on the use of medicines; Part II relates to injuries and wounds and their treatment; Part III, to sudden attacks, painful attacks, pain in the chest, and pain in the stomach; Part IV, to some common ailments and diseases of the skin; and Part V, to diseases of infancy and childhood; numerous particular forms of attack being described under each heading.

A *Manual of Physics* for university students, prepared by Prof. *William Peddie*, of Edinburgh, has been issued by G. P. Putnam's Sons (price, $2.50). It is a treatise of a high grade, and is confined to pure science. It makes large use of mathematics, but the author states that the student may assume the results of the mathematical portions, and use the remainder, which is much the larger part, of the text in his study of experimental physics. The volume has an index, and there are over two hundred diagrams in the text.

The ejection of blood from the eyes of the lizards of the genus *Phrynosoma*—popularly called horned toads—is now attracting considerable attention. In the *Proceedings of the United States National Museum*, *O. P. Hay* gives a very interesting account of his experiments with this lizard. It appears that upon irritating the animal blood spurts from just above the eye. For what purpose the horned toad thus besprinkles an enemy with his own blood, what is the source of the blood, and how is it expelled with such force, are the questions that are puzzling biologists. It is suggested that the purpose of the ejection is to defend the animal from the attacks of enemies, although it seems improbable that the discharge would seriously pain or affect an enemy; however, Mr. Hay thinks it likely that this is the purpose of the habit, and he says: "A discharge of blood into the eyes of some pursuing bird or snake might so seriously interfere with its clearness of vision that the lizard might make its escape while its enemy was wiping its eyes."

The determination of the source of the blood has offered serious difficulties to the investigations of biologists, the most probable theory being that the blood or matter is lodged in a blood sinus upon each side of the head, a portion of the wall lying on the inner surface of the eyelid. This sinus is supposed to be surrounded with muscular tissue of sufficient force to cause the thin wall in the lid to be ruptured and the blood to be ejected to a considerable distance. These toads are found in nearly all parts of California, and are called by the Mexicans "sacred toads," "because they wept tears of blood."

In the *Contemporary Review* Prof. *A. H. Sayce* contributes a valuable paper to philological literature, which he entitles The Primitive Home of the Aryans. Until recent years the accepted belief was that the parent speech had its home in Asia, probably on the slopes of the Hindu Koosh. The parent speech of the Indo-European languages was entitled the *Ursprache*, or "primeval language"; but, as linguistic history developed, this supposition was abandoned, for it was found to differ from Sanskrit or Greek only in its fuller inflectional character. Sanskrit then became the parent, and its home was determined to be in Asia, the choice being fixed upon two arguments, the first of which is linguistic, the second being historical. "On one hand it has been laid down by eminent philologists that the less one of the derived languages has deflected from the parent speech the more likely it is to be geographically nearer to its earliest home"; . . . and, "as Sanskrit was held to be the most primitive of the Indo-European languages to reflect clearly the features of the parent speech, the conclusion was drawn that that parent speech had been spoken at no great distance from the country where the hymns of Rig-Veda were first composed." Prof. Sayce, however, draws attention to the fact that the result of recent discoveries has been a complete revolution in the study of Indo-European etymology; and that whereas, ten years ago, Sanskrit was invoked to explain Greek, "it is to the Greek that the new school now turns to explain Sanskrit." He claims, with Dr. Penka, that "southern Scandinavia was the primitive 'Aryan home,'" and he adds that "a more profound examination of Teutonic and Keltic mythology, a more exact knowledge of the words in the several Indo-European languages which are not of Indo-European origin, and the progress of archæological discovery will furnish the verification we need" to establish that in Europe and not Asia was the home of the parent speech.

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## POPULAR MISCELLANY.

**The Scientific Meetings at Madison, Wis.**—The coming meeting of the American Association for the Advancement of Science will be held in Madison, Wis., August 16th to 23d inclusive. Previous to the former date, the American Microscopical Society will meet August 14th, 15th, and 16th, under the presidency of the Hon. Jacob D. Cox; the Geological Society of America, August 15th and 16th, Sir J. William Dawson, president; and on the same days the Association for the Promotion of Agricultural Science, Prof. J. P. Roberts, president; the Association of Economic Entomologists, Dr. S. A. Forbes, president; and the Association of State Weather Service, Major H. H. C. Dunwoody, president; and after the adjournment, the International Botanical Congress. The meetings of the Botanical and Entomological Clubs will be sandwiched between those of the association. Free excursions will be

given on the Saturday to Devil's Lake, about forty miles from Madison, and the Dells of the Wisconsin River, about eighty miles distant; besides three excursions of sections. The International Botanical Congress will consider questions of botanical interest, but papers embodying the results of research will be excluded, and the International Standing Committee upon Nomenclature is expected to make its report. Mr. William Harkness will be president of this meeting of the American Association; and the sectional vice-presidents will be: (A) Mathematics and Astronomy, C. L. Doolittle; (B) Physics, E. L. Nichols; (C) Chemistry, Edward Hart; (D) Mechanical Science and Engineering, S. W. Robinson; (E) Geology and Geography, Charles D. Walcott; (F) Zoölogy, Henry F. Osborn; (G) Botany, Charles E. Bessey; (H) Anthropology, J. Owen Dorsey; (I) Economic Science and Statistics, William H. Brewer.

**Large Game.**—Among the animals described in Mr. Rowland Ward's Measurements and Weights of the Great Game of the World, precedence is given to the hippopotamus of Africa. Not unlike him is the manatee, now extinct in the West Indies, but surviving in the upper Amazon. Both kinds of marine cattle, observes the Saturday Review, graze upon water weeds at the bottoms of the streams; but the manatee is harmless under all circumstances, while the hippopotamus sometimes plays the part of an assailant. A very formidable enemy he can be, for his massive tusks—all tusks are measured at the root—are sometimes more than nine inches in circumference. Still more dangerous are the razor-like tushes of the boar, and they are none the less dangerous that they are short. The greatest length of the outside curve is given at ten inches, and yet the boar has been known to come off victorious in a battle with the Bengal tiger. In contrast with one another stand the muntjac, a deer of India and the warm countries of the southern Pacific, with a "sweep" of horns of only six inches and a half, and the sambur, which weighs six hundred pounds and has a "magnificent" spread of antlers of two feet and a half from tip to tip. The best of the American wapiti is more than half as large again as the Scottish red deer, and the grand Carpathian species yields in size to the extinct Irish elk. Generally speaking, we find that the weight of deer depends partly on the climate, but chiefly on the food. The caribou, or reindeer, is an exception. The farther north you find him, the better he seems to thrive, and, like the musk ox, he fattens on the arctic lichens; and the moose, which haunts more southerly forests and swamps, is decidedly smaller. There are some remarkably graceful dwarfs of the deer tribe. Kirk's antelope of East Africa wears Lilliputian horns three inches long; and Salt's antelope from Somali Land is still more minute. The beautiful little gazelles of Oriental poetry seem to do well anywhere; apparently they can dispense with water and lay on flesh in a wilderness of sand and stones. Naturally, they are always in high condition, and it is no easy business to ride them down. A very remarkable group are the wild sheep and goats which have been attracting so many adventurous rifles to the Rocky Mountains and Sierra Nevada, to the Himalayas and the plateaus of Kashmir and Thibet. The horns of the finest Himalayan ibex which was killed by Mr. Kennard had a span of four feet and a quarter. Those of a wild goat from southeastern Europe, which fell to Colonel Marston's rifle, were a trifle longer. These, again, are surpassed by the curve of the best markhor, a denizen of the higher Himalayas, resembling the goat. When you cross the Indus into Afghanistan, the curved horns of the markhor are curiously straightened and fall away in length by a fourth. The length of the longest tiger skin after drying is said to be thirteen feet six inches; but it must be noted that skins expand considerably in the curing. The greatest length of a skin undressed is given as ten feet two inches and a half.

**The Company of the Dead.**—In Mr. Charles Hose's journeys in North Borneo, he found one morning after his night's rest that the remains of his host's last wife also occupied the room, where they were kept in a large box serving as a coffin. It is the custom of these people to keep a corpse in the house for three months before burying it. The body is then removed from the house and conveyed with much ceremony to the tomb. Every one present sends one or more cigar-

ettes made of tobacco, wrapped in the dry leaves of the wild banana, to his dead relatives in "Apo Leggan" (hades). These cigarettes are placed on the top of and around the coffin; and, should the body be that of a man, his weapons, tools, and a small quantity of rice, with his *priok* (cooking pot), are deposited in the tomb with him that he may be able to continue his daily pursuits in the other world. But if of a woman, her large sun-hat, her little hoe—used for weeding in the paddy fields—her beads, earrings, and other finery are placed with her body, that she may not be found wanting on her arrival the other side of the grave. Mr. Hose was once present when the corpse of a boy was being placed in the coffin, and he watched the proceedings from a short distance. As the lid of the coffin was being closed an old man came out on the veranda of the house with a large gong and solemnly beat it for several seconds. The chief, who was sitting near, informed him that this was always done before closing the lid, that the relations of the deceased who had already passed out of this world might know that the spirit was coming to join them. There was another strange ceremony at which he was once present, called "Dayong Janoi," in which the dead are supposed to send messages to the living, and which proved that "spiritualism" was of very ancient practice among the Kayans.

**Heat Phenomena of the Diamond.**—In his experiments with the diamond Mr. Moissan has found that, in his thermo-electric apparatus for burning in oxygen, when the temperature was slowly raised the combustion proceeded gradually without the production of light; but if the temperature was raised 40° or 50° C. above the point at which this slow combustion begins, a sudden incandescence occurs, and the diamond becomes surrounded by a brilliant flame. Various deeply colored specimens of diamonds burned with production of incandescence and flame at temperatures of from 690° to 720° C., but transparent Brazilian diamonds did not attain the stage of slow combustion without incandescence till the temperature of from 760° to 770° C. was reached. A Cape diamond suffered gradual combustion at from 780° to 790° C. Specimens of exceedingly hard boort began to combine with oxygen at 790°, and burned brilliantly at from 840° to 875° C. When Cape diamonds were heated with hydrogen to a temperature of 1,200° C., they remained unchanged; but if the stones had previously been cut, they frequently lost their brilliance and transparency. Dry chlorine gas was found incapable of reacting with the diamond until a temperature of from 1,100° to 1,200° C. was attained. Hydrofluoric-acid vapor likewise only reacted at about the same high temperature. Vapor of sulphur also requires to be heated to 1,000° C. before reacting, but in the case of black diamonds bisulphide of carbon is produced at about 900° C. Metallic iron, at its melting point, combines with the diamond in the most energetic manner; and it is a point of considerable interest that crystals of graphite are deposited as the fused mass cools; hence the experiment forms a striking method of converting the allotropic form of carbon that crystallizes in the cubic system into that which crystallizes in the hexagonal system. Melted platinum likewise combines with the diamond with great energy.

**Hurry, and the Chance of Life.**—In a paper on The Duration of Life of the Nervous American, Dr. Julius Pohlman asks, "Is this so often quoted 'fearful nervousness' and 'early death' a fact or merely an assertion? What proofs have we for it? It seems very plausible, indeed, and apparently correct physiological reasoning to say that the individual's longevity is in inverse proportion to his daily hurry, all other things being equal. But not many years ago the equally misleading but equally plausible statement was accepted that the human race was growing smaller with the advance of civilization. "First of all," the author continues, "the assumption that increased activity and greater hurry mean more rapid wearing away of the body ignores the fact that the human body is a wonderful piece of machinery, which not only renews itself constantly, but whose strength and power of endurance and capacity for more work increase with increased use up to the point at which use becomes abuse. At what time and under what pressure this danger line is reached depends upon the individual." The testimony of the executive officers of four of our largest life-

insurance companies is quoted to show that "from the material standpoint of dollars and cents the life of the American is at least as good as, if not better than, that of the European, all other conditions being the same. And if we remember that probably the majority of the holders of policies of life insurances in this country is made up from those same active, pushing, and rushing men, a class among which death from overwork would naturally occur most frequently, then the figures mentioned acquire additional force. A compilation drawn from every available source regarding the estimated duration of life at different years of age in America and in Europe gives figures that show that the chances of the American, from early manhood to a good old age, are, all through, a little better than those of his English brother, and a good deal better than those of the Germans.

**Funeral Customs of the Haida Indians (Queen Charlotte Islands).**—According to the Rev. C. Harrison, all men, and particularly the chiefs among these Indians, are greatly honored on their departure from this world. When the man dies, the next to succeed him (generally his nephew) is presented with blankets, dishes, beads, guns, canoes, prints, pottery, dogs, axes, and furniture. They are not, however, for his own benefit, but for the benefit of the deceased, and those who take part in the burial ceremony. In fact, nothing seems to be too valuable for the funeral. Christians are afraid to break the news of a friend's death to his wife, father, and mother. Not so, however, with the Haidas. The author has seen them make the coffin and decorate it in the presence of the sick person when they have come to the conclusion that he is about to die. They also tell the sick man that he will not recover, and urge him not to attempt to do so. The members of his tribe and all the chiefs of the other tribes come in to see him, and talk of nothing else but of others who have had the same sickness and died. When he hears what they have determined that he should do, he then refuses to eat and drink, and so hastens the demise. When gasping for breath, he is washed, and his shroud, made of white cotton, is then put on; white stockings are put on his feet; he is clad in a pair of white woolen drawers, and a white handkerchief is tied around his head. His neck is encircled with beads, a spot of red paint is put on either cheek, and a black spot on his forehead. When thus arrayed, all his friends enter the house and wait until he dies. They think very little of each other when in health and strength, but as soon as they are dead they become valuable and are called good Indians. When a person dies, they arrange a bed in the corner of the house and cover it with white cotton and place the deceased thereon, and then they cover him with a sheet of the same material. In twenty-four hours' time the body is placed in the coffin and arranged in the position in which it is to be buried. Then the time of mourning comes. All the old women of the tribe and the friends and relatives of the deceased begin to groan and sigh and cry. After they have wept for one or two hours, the greatest chief present calls for silence. Then the smoking feast begins. During the smoking entertainment the chiefs and friends of the deceased, according to rank, will begin to extol his virtues, and try to console his relatives by reference to his disposition toward the poor, his love for his friends, and his kindness toward his wife and children; and they also are very careful to refer to his liberality when making a free distribution of his goods—namely, a *potlatch*. Everything done in his past life passes under review, and they then conclude by saying that his time had come, and that the gods wanted him, and he, being a good and wise man, had obeyed their summons. When any one of importance dies, the news is carried to all the villages, and they at once come to see the dead man and also consult with the relatives regarding the funeral arrangements. If the deceased person belonged to the Bears, the funeral preparations are made and conducted by the Eagle Crest, and *vice versa*. After the funeral is over, all the people are feasted by the deceased man's nephew, who then assumes his uncle's title and property.

**Self-purification.**—The results of recent discussions in Europe, in which Prausnitz, Prof. Pettenkofer, Prof. Buchner, and Prof. Frankland have taken part, indicate that "self-purification" of rivers by oxygenation and sunlight, while it may be sufficient

for water applied to ordinary uses, can not be relied upon for the perfect sanitation of water intended for drinking. This conclusion is confirmed by the recent experience of some towns in Massachusetts. Continued outbreaks of typhoid fever in Lowell and Lawrence were ascribed by the State Board of Health in 1890–'91 to the admission of typhoid-fever excreta into the river from towns higher up the stream, where it was known to have existed. Newburyport has for the past ten years, or since the introduction of a public water supply, been comparatively exempt from typhoid fever; but recently, in consequence of a scarcity of water, the water company began pumping a part of its supply from the river and distributing it to the inhabitants in the face of expert warning against doing so. In January, 1893, the cases of typhoid fever, following closely after a similar prevalence in Lowell, suddenly rose from an average of less than one a month to thirty-four in January, with five deaths.

**East African Superstitions.**—Mrs. French-Sheldon, who traveled in Africa from Teita to Kilimegalia and secured a propinquity to the natives under natural conditions rarely enjoyed by white travelers, became acquainted with some very curious superstitions among them. The people of Taveta have an idea that the preservation of the skull preserves the spirit of the dead, and that the congregation of the skulls of a family or tribe guarantees a future reunion. They avoid letting any stranger know of the death of one of their tribe. If a familiar face is missed, and an inquiry is made, some one promptly says, "He has gone on a journey." They have a horror of having their pictures or photographs taken. They wear certain beads and bits of wood or iron as charms to ward off evil, and as *dama* for various complaints. They are loath to part with these beads, beans, or bones. They will lend them to one another when suffering, but always reclaim them when their friend has been cured. The fires in the village were never allowed to go out; a special family fire might go out, but this could be resupplied or reignited by getting a blazing fagot from some friend's fire. But in the history of the tribe they had always preserved the fire, as doubtless did their prehistoric ancestors. When the Wasombo learned that Mrs. French-Sheldon intended to descend to Devil's Water, as Lake Chala was called by them, they speedily retreated to their villages, with a feeling of horror that the white woman would dare to venture into the very mouth of the devil. She therefore made her visit free from annoyance. It is believed that the Masai had a village where the crater lake now swells and gurgles, and that during a volcanic eruption of Kilimanjaro the people and their herds and poultry were blown into mid-air, and that their spirits still hang in space, without home above or below, and that the moaning and soughing of the wind through the trees and the strange rustling and mysterious noises caused by the reverberation of the rocky cliffs surrounding the lake proceed from the spirits of these poor people, their cattle and poultry. Although fish are abundant in this lake, the natives could not be induced to taste them. The same people believe that their ancestors inhabit the bodies of the Colobus monkeys, and will not under any circumstances knowingly kill or permit to be killed one of those animals; and on approaching the forest where the monkeys abide in great numbers, they preserve an odd silence, with furtive glances, and pick their steps with a precaution and almost hesitation that indicate an honest belief in their superstition.

**Prehistoric Jeweled Teeth.**—Among the interesting objects brought from Copan last year by Messrs. Saville and Owens, of the Peabody Museum of American Archæology and Ethnology, are several incisor teeth, each of which contains a small piece of green stone, presumably jadeite, set in a cavity drilled on the front surface of the teeth. The museum had before received from Yucatan human teeth filled in a peculiar manner, and now it has teeth from Copan filled in the same way. This is of particular interest in adding one more to the several facts pointing to Asiatic arts and customs as the origin of those of the early peoples of Central America. A most striking resemblance to Asiatic art is noticed in several of the heads carved in stone; one in particular, if seen in any collection and not labeled as to its origin, would probably pass almost un-

challenged as from southern Asia. These may prove to be simply coincidences of expression of peoples of corresponding mental development brought about by corresponding natural surroundings and conditions.

**Photographing Savages.**—A lively use of the camera is recommended by Mr. E. F. Im Thurn as a means of getting representations of savages in their real life. The usual illustrations in works of anthropology and travel, when they are not merely physiological pictures, are pronounced by him almost universally bad. "Of old, the book illustrator, if, as was usual, he was not himself the traveler, drew as pictures of primitive folk merely the men and women that surrounded him, figures of men and women of his own stage of civilization, and merely added to these such salient features as he was able, from the traveler's tales, to fancy that his supposed primitive subject had. . . . The modern anthropological illustrator does indeed generally draw from photographs, but almost always from photographs taken under non-natural conditions." They are either taken in town, where the savage is away from his usual haunts and in unaccustomed surroundings; or the mere thought that he is being photographed puts him under constraint. "That to gain the confidence of uncivilized folk whom you wish to photograph is one of quite the most essential matters you will easily understand. The first time I tried to photograph a red man was among the mangrove trees at the mouth of the Barima River. My red-skinned subject was poised high up on a mangrove root. He sat quite still while focused and drew the shutter. Then, as I took off the cap, with a moan he fell backward off his perch on to the soft sand below him. Nor could he by any means be persuaded to prepare himself once more to face the unknown terrors of the camera. A very common thing to happen, and to foil the efforts of the photographer at the very moment when he has but to withdraw and to replace the cap, is for the timid subject suddenly to put up his hand to conceal his face, a proceeding most annoying to the photographer, but interesting to the anthropologist, as illustrating the very widespread dread of primitive folk of having their features put on paper, and thus being submitted spiritually to the power of any possessing the picture. . . . A curious instance may be mentioned of the discovery, thanks to the camera, of that rather rare thing—a personal idiosyncrasy among red men. Some time last year in photographing a number of Carib lads I noticed that one of them at the moment of the taking of the picture suddenly put up his hands and put them, not over his face, but one on each shoulder. The attitude struck me at once as an unusual one, but yet it seemed to me in some way familiar. Some time after, in looking through my old stock of negatives, I found one which showed a much younger Carib lad in the same unusual attitude, and it was only after some inquiry that I realized that this last-named negative was one which I had taken some years before of the same boy." There is a field here for the use of some of the "snap" instruments.

**The Reasons of Conventionalities.**—Conventionalities are treated by the London Spectator as things which must grow up with the growth of civilization, yet which, while they are not to be despised, are no more to be exalted into absolute and universal obligations. Even on matters affecting merely the external order and harmony of life, there are conventions which, though not intended to repress and exclude all overflow of individual genius, are still of great value in controlling the arbitrary eccentricities of individual nature, and in reducing men's manners and modes of expression to terms which one might speak of as commensurable with the manners and modes of expression of those who live with them in the same moral atmosphere. The mere beauty of any social life depends on the conformity of all—within variable but definite limits—to conventions, which, though by no means of supreme obligation, yet render the give-and-take of life much more natural and gentle and easy than if each man or woman were to blurt out the feeling uppermost in the individual mind, without any of that toning-down and softening which exclude abrupt and noisy explosions of individual self-will. Not all social conventions are beautiful. Sometimes the artificiality of them exceeds whatever is either necessary or advantageous for the pur-

pose of mutual understanding and mutual forbearance; yet some of them are in their essence beautiful, because they are founded on the principle of charity as well as truth. They control jealousy and rivalry; they repress vulgar competition; they express disinterested sympathy. In fact, they transform a selfish mob into an orderly society. Still, though without these etiquettes and courtesies of civilization social life could hardly exist, yet it would be impossible to speak of any of the conventions which render it possible as if they were laws of intrinsic and moral obligation to which there are no exceptions. They are but principles which govern the average or ordinary usages of men, but none the less principles which give way, and rightly give way, before any urgent individual need, or even any moderate pressure of clear utility.

**Chinese Newspapers.**—The Chinese Government instituted an official journal at a very early date, the Pekin Gazette having existed since B. C. 740. It was at first printed upon engraved wooden blocks, but now movable characters cut in wood are used. There are three editions of the paper, of which only the official edition is printed in this manner. The second edition is printed with waxen plates on which the characters are cut, and, the work being done in haste, is not very legible. The third edition is in manuscript. The official edition is printed on one side of ten or twelve very thin doubled leaves, is eighteen centimetres high and ten broad, and is divided by lines of violet ink into seven columns, each containing fourteen ordinary characters. It appears every morning. The manuscript edition is a little smaller than the official edition, and appears several days before it. Its price is many times higher, and it is largely used by foreigners. The journal furnishes a real panorama of the official and social life of the Chinese. The reading of it is very entertaining; for we may find in it, among other documents, the day which the emperor has decided upon for changing from the winter hut to the summer hut; that six of the candidates for the license were more than ninety, and thirteen more than eighty years old, illustrating the fact that one is never too old to be examined in China. This Pekin Gazette was the only journal published in China till about twenty years ago. Since then some five journals have arisen at Shanghai, Tien-Tsin, at Canton, at the instance of the English, with the co-operation of Chinese literati. The Chen Pai, of Shanghai, which was started in 1885, is an illustrated weekly journal, with eight doubled leaves and a red cover, the engravings in which are done in Chinese style in outline. In one of the numbers of this journal the last conflict between the French and the Chinese is represented, with the French commander Fournier in the costume of an English admiral. All the journals together publish not more than fifteen thousand copies. The attempts made in them to transcribe European words phonetically are sometimes amusing, thus *ultimatum* becomes "ou-ti-ma-toung"; *statu quo*, "sseu-ta-tou-ko"; telephone, "to-li-foung," etc.

**The Fire of Incandescent Lamps.**—An active incandescent lamp may be broken in the midst of cool combustibles, even of gun-cotton, without setting them on fire, so rapid is the destruction of the carbon filaments in the open air. But a long continuance of the lamp in immediate contact with a combustible envelope may determine ignition, the more readily the more slowly heat and air pass through the envelope. Thus gummed cotton or other goods will take fire more rapidly than similar goods ungummed or loose. Some interesting experiments in this property have been made by an Austrian engineer, Captain Exler. Having determined the temperature produced by certain measured lamps in paraffin in which they were plunged, he washed them with pulverin, ecrasite, and powdered gun-cotton; no change took place in their condition. In thicker coatings ecrasite fused, and the powder slowly lost its sulphur, but neither took fire. The effects were more marked when the substance was spread upon a surface capable of wholly arresting calorific radiation. It is therefore prudent to guard against bringing naked lamps too close to a combustible surface. When the lamp was surrounded with an envelope, the temperature between the two surfaces rose. In fifty minutes it became sufficient to decompose fulmicotton and carbonize wood. Black

powder lost all its sulphur, but did not take fire. With a lamp inclosed in a bell glass the three explosive substances were decomposed in twenty minutes. Water, with which the interval was filled, came to the boiling point in fifteen minutes. It was observed even when the beginning of an ignition of the explosives was determined, the flame was not sure to be propagated, unless the substance had been previously warmed. On the other hand, a derivation of weak resistance, produced between the two conductors of a lamp, determines a strong flame, capable of igniting all combustible substances. A lamp may be broken by a shock, by overheating, or by some unknown cause. If only a crack is formed, the air getting within causes the filament of incandescent carbon to burn up in a very short time. If the lamp bursts or has a hole made in it, the danger is greater, and may cause the ignition of explosive gases, but not of fulmicotton or dry powder. It is not safe, therefore, to conclude that an accident is absolutely impossible.

**The Whirlpools of Charybdis and Scylla.**—Charybdis and Scylla, the whirlpools of which much was fabled in classical antiquity, are situated in the strait of Messina, between Sicily and Italian Apulia. Although they were a great terror to ancient navigators, they are in reality rather small affairs, and it is difficult to determine their exact positions. The whirlpool of Scylla is situated at the foot of the cliffs on which is the little city of that name, which are hollowed out into caverns. The circulation of the waves in these grottoes produces, in times of heavy seas, a sound like the barking of a dog. Charybdis is near the port of Messina, nine marine miles from Scylla. Although it was reported unfathomable, it is, according to Spallanzani's measurements, not more than five hundred feet deep, and is therefore far from being the deepest spot in the Mediterranean. It is difficult to comprehend why the ancients should have had such a terror of sailing between these two eddies so far apart, but the task of explaining the riddle has been undertaken by the engineer, M. Keller. Observations made by him at Messina show that the currents of the strait depend, first, on the tide, and, secondly, on the wind. The currents are very strong, because the tide is low in the Ionian Sea when it is high in the Tyrrhenian Sea, and *vice versa*. Hence, also, the formation of whirlpools at different points in the strait. These whirlpools are energetic in proportion to the strength of the current, and when at their strongest may offer a serious danger to navigation. At the syzygies, with the wind from the southeast, the waters tumble from the Ionian Sea into the strait and form whirlpools north of the port of Messina; they are likewise formed near Faro, where ships at anchor are sometimes carried out to sea and borne by the current upon the rocks of Calabria, toward the point of Pezzo, a little farther away than Scylla. We may therefore suppose that the ancients meant by Charybdis these casual whirlpools near the port of Messina, and by Scylla those of Point Pezzo. Between these two points the currents are extremely rapid and strong and variable besides. Under such circumstances an inexperienced sailor might therefore have difficulty in passing the strait of Messina without falling from Charybdis into Scylla. The danger is really serious for sailing vessels, which were the best the ancients knew of.

**Consumption at Davos Platz.**—A case is recorded by Dr. A. T. T. Wise, of Davos Platz, Switzerland, of a consumptive manifesting serious symptoms ordered to that place for the mountain air, who began to regain lost ground in two weeks after his arrival, near the end of October, 1891. Progression toward recovery, with gradual expansion of the chest and gain in weight, was uninterrupted till February, 1892, when the physician's examination showed improvement near to recovery in every affected part. In October, 1892, the patient, having gained twenty-eight pounds in Davos, had resumed his practice of medicine, was in robust health, and presented no sign of disease except a faint, hardly perceptible expiratory harshness over the left apex. The climatic advantages at high altitudes in pulmonary disease, as summarized by Dr. Wise, are: Dryness of the air and its comparative freedom from micro-organisms and atmospheric dust, entailing a lessened liability to catarrh and irritation of the bronchial tract and drying the lungs; profusion of sunlight; with the

low temperature, the heat of the sun is easily borne, and the violet rays of the spectrum act chemically on the blood, increasing the hæmoglobin; diminished barometric pressure, which facilitates chemical action in the blood and tissues, favors vaporization of moist secretions in the lungs, and aids pulmonary circulation and expansion; and the general stimulus of high levels, producing exhilaration and an increase of nutrition.

**Facts about the Growth of Boys and Girls.**—A summary of the results of an investigation of the laws governing the growth of various parts of the body, instituted in the schools of Worcester, Mass., in 1891, is published in Science. Some three thousand two hundred and fifty individuals were examined, of ages ranging from five to twenty-one years, and comparisons were made in the growth of boys and girls. The length of the head in girls is shown to be less than that of boys throughout the whole period of growth, and consequently through life; but the difference in length, instead of remaining the same from year to year, varies considerably, and the annual increment is irregular in both sexes. In girls the greatest length of head is reached about the eighteenth year; in boys, not before the age of twenty-one. The girls' heads are narrower than those of the boys, while the phenomena of breadth of head, in periods of alternate growth and cessation of growth, are similar to those of length of head. The faces of the girls are broadest at seventeen, those of the boys after the eighteenth year; while the faces of the boys are usually broader than those of the girls. In stature, the boys, starting out at five years of age, are apparently taller than the girls, but the girls appear to catch them in the seventh year, and continue at an even stature up to and including the ninth year, after which the boys again rise above the girls for two years. About the twelfth year the girls suddenly become taller than the boys, and continue taller until the fifteenth year, when the boys again and finally regain their superiority in stature. After the age of seventeen there seems to be very little if any increase in the stature of girls, while the boys are still growing vigorously at eighteen, and probably continue to grow for several years after that age. The curves of the sitting height present the same characteristics, somewhat more accentuated, as the curves of stature. The curves of weight, while presenting the general characteristics of the curves of stature and sitting height, show minor differences. The superiority of the girls in respect to weight is for a much shorter period than in respect to total height or sitting height. In weight also the girls seem to reach their maximum average at seventeen, while the boys continue to increase in average weight until a much later period in life. The movements of the curves of the index of sitting height indicate that the greater part of the growth in stature up to the twelfth year in girls and to the fifteenth year in boys is made in the lower limbs, while after these respective ages it is made in the trunk. The results of the whole series of measurements afford evidence, deemed conclusive, that women reach maturity before men, and that, for all the measurements except the weight, girls have completed their growth by their eighteenth year.

**Paradoxes of the Witch-hazel.** — The witch-hazel, according to a correspondent of Garden and Forest, is a true witch among shrubs. It has a wild way of growth, several crooked, branching trunks growing from the root; smooth leaves; four very long, linear petals, yellow and twisted or curled. So far it is not unlike other shrubs. The name "hamamelis" indicates its most striking peculiarity, "flowers and fruit together on the tree." It blossoms in October and November, and the flowers of this fall will be the fruit of next fall, which hangs on the bare boughs when it next blossoms. The flowers, though small, are made noticeable by blossoming in clusters on the stem. The fruit is a woody capsule, nut-like, two-celled, and the seeds, almost black and shining, are the prettiest seeds in the world. Another peculiarity of this curious shrub is its explosive seed-scattering. "Many years ago, wishing to secure a quantity of these seeds to make a necklace like one I had seen, it became a question how to get them. Before the nut was ripe enough to open, it was almost impossible to get at the seeds, and when the capsule opened they were shot out suddenly, scattered far and near, and lost. A quantity of the almost ripe seed-pods were

gathered, put in paper bags, and hung up to wait and see, or rather to wait and hear, what would happen. For days these pods, as they dried, kept popping in the bags, and the seeds, small and polished, very like rice in shape, were secured. . . . But when the seeds were gathered there was another problem to be solved—how to thread them. The finest, sharpest needle would split them every time. The friend who had threaded them told me how it could be done. The seed was to be cut off at each end with a very fine file. This was a labor of love, and the necklace was pretty enough to pay for the trouble."

**Crystallization of Metallic Oxides.**—M. Moissan has succeeded, with the high temperature obtained in a newly devised electrical furnace, in fusing and crystallizing many of the metallic oxides. At temperatures ranging from 2,000° to 3,000° C., magnesia, lime, and strontia crystallize and then quickly melt; boric acid, protoxide of titanium, and alumina are volatilized; and the oxides of the iron family, stable at high temperatures, furnish melted masses bristling with little crystals. These important results were only the prelude to still more remarkable experiments intended to lead up to the preparation of carbon under high pressure, and the artificial production of the diamond. Having studied the solubility of carbon in a certain number of metals in fusion—such as aluminum, iron, manganese, chromium, uranium, silver, and platinum—and in a metalloid, silicon, he succeeded in obtaining by fusion in one of these metals new varieties of graphite; but he was able to produce crystallized carbon, or diamond, only by performing his experiments under high pressure. When iron in fusion is saturated with carbon, different results are obtained according to the temperature to which the mass is raised. Between 1,100° and 1,200° C., a mixture of amorphous carbon and graphite is obtained, and at 3,000° C. graphite exclusively in beautiful crystals. If a high pressure is introduced, the conditions of crystallization are completely changed. The process employed by the author resulted in the production of three kinds of carbon—graphite in small quantity when the cooling was quickly done, a carbon of a chestnut color in very thin flakes, and a small quantity of a dense carbon which was isolated by treatment with the strongest acids. The very minute fragments scratched rubies and burned in oxygen at 1,000° C. They seem, therefore, to be incontestably diamond. Some of the fragments are black and others transparent. M. Moissan's reporter speaks of his having, in the production of these diamonds, surprised one of the secrets of Nature—ignoring the diamonds obtained several years ago, under a similar high pressure, from hydrocarbons by Mr. Hannay, of Edinburgh.

**East African Finery.**—Among the presents which Mrs. French-Sheldon received from the Masai when passing through the East African country called Kilimegalia, were the characteristic articles, a vulture-feather pannier, vulture-feather shoulder capes, dancing masks of various kinds, shields, swords, and a collarette made of cropped ostrich feathers stuck through leather, so that the quills make a rough surface on the inner side. "This is worn only by the warrior who has killed twelve persons, and resembles in theory the robe of Janus, as the roughness on the inner side produced by the quills excoriates the surface of the neck of the wearer. The warrior who gave me this collar had the blood streaming from his throat to his waist. One warrior presented me with a wooden case filled with ostrich feathers, which he carried with him to replace the feathers in his warrior mask and for other decorations. I bought several of the cow skins worn by the women as clothing and for bedding at night, for the cold is extreme. They presented me also with a dancing wand, and one of their *nebana*, or cloths made of strips of white cotton and embellished with red, of various designs, which they sling from their shoulders; also a colobus monkey tail, which they wear under their knees, over the long oval bells, and a hyena tail decorated with a lion mane and colobus monkey tails, which they suspend from their shoulders as an emblem of war."

**The Masais of East Africa.**—The Masais of East Africa, according to Mrs. French-Sheldon, are true warriors and raiders. They keep a subject tribe, the Wa-sombutta, who do their hunting and what meager agriculture they indulge in. The people of this tribe are insignificant in appearance, and, al-

though servile and subject to the Masai, are not slaves. They present almost the appearance of dwarfs. "I saw no man among them," she says, "who attained a height of over four feet and a few inches; most of them were very much smaller. The Masai know no law but that of capture, and attack the Taveta with much animosity. Their custom of forbidding passage through their territory is enforced by placing in the middle of the path, over which an individual or a caravan must pass, a bullet over which they cross two twigs stripped of foliage, with the exception of a tufted top; the first person crossing this barrier is usually speared or shot. Not knowing of this custom, I inadvertently came to such a barrier and kicked it aside, when I was seized by one of my headmen, who held me back, informing me that if I crossed that point I should most likely be assassinated; and in a moment about thirty young Masai warriors made their appearance in a great state of agitation, with frantic gesticulations, announcing that I must pay a certain amount of *hongo* for the depredation I had committed." The author had great difficulty in getting even instantaneous photographs of any of the tribes. They regarded the camera as a species of witchcraft, and were put to flight the moment they saw a square box held up before them. But they were greatly entertained by the music-box; and the principal men of the tribe would sit by the hour round the tent while it was playing, waving themselves backward and forward, and repeating "God! god! god! give us rain! god, give us clothes!" until Mrs. French-Sheldon began to feel that her resources in the way of exerting influence with the supreme power were very much overtaxed.

**Platinnm and its Sources.**—Platinum is used in the manufacture of incandescent electric lamps, in the construction of stills for the concentration of sulphuric acid, as material for the wires by which artificial teeth are fastened to plates, and in smaller quantities for chemists' crucibles, jewelry, etc. For all these purposes about 215,000 ounces are consumed every year. The Ural region of Russia has for many years supplied all the platinum used in the world. Other mines of far less productiveness are in the United States of Colombia, British Columbia, and the United States. Colombia produces about a hundred and twenty-five kilogrammes of the metal, all from native washings. The platiniferous area, although of low grade, is very extensive, and in part suitable for hydraulic mining. A considerable quantity of American capital, it is said, has been invested there, and Colombia is expected to become an important producer of the metal. The only platinum deposits of importance in British Columbia are on the Talameen River. The total production of this province is about sixty-five kilogrammes. Much prospecting for platinum has been done in the United States, but so far without success in finding paying quantities, and to the present time all the platinum produced has been incidental to the production of gold from various auriferous gravels in California and Oregon.

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## NOTES.

According to a paper by Miss Millicent W. Shinn, the great refractor of the Lick Observatory and the observatory itself may be traced to Mr. Lick's desire to be immortalized by leaving bequests for costly statues of himself and family. He was told by Mr. Staples that "more likely we shall get into a war with Russia or somebody, and they will come round here with war ships and smash the statues in pieces in bombarding the city." Mr. Lick was so struck by this that he asked, "What shall I do with the money, then?" when the suggestion of the telescope was made.

Many of the allusions and much of the science found in sixteenth century literature, including the works of Jonson, Spenser, Marlowe, Massinger, and Shakespeare, are derived from the *De Proprietatibus Rerum* of Bartholomew Anglicanus, a Franciscan monk, which was written in Latin about the middle of the thirteenth century, and was translated into English by John of Trevisa in 1397. The work affords a curious insight into the ideas of our ancestors about natural phenomena, and into their credulity in believing the stories of wonders from far countries. Much of it is derived from ancient authorities. A budget of selections from this book has recently been published in London.

The oscillation of projectiles is photographically recorded by Prof. Neesen, of Berlin. He employed hollow projectiles, in the interior of which was placed a sensitive plate, illuminated by sunlight through a small opening. During the rotatory flight of the projectile the ray of light described curves

on the plate, from the position of which, taken in conjunction with that of the sun, the oscillations of the axis and point of the projectile could be calculated. The results obtained showed that both perform oscillatory movements during flight very different from those usually believed to take place.

Two Akka girls, representing the dwarf race of Africa on exhibition in the European cities and supposed to be between seventeen and twenty years old, are described as being well proportioned, and as tall as a boy eight years of age. Their behavior is infantile, wild, and shy, but without timidity. They are very different in disposition; the more pleasant one laughs joyously, is pleased with bead bracelets and other trinkets given to her, and curiously expressed her appreciation of some chocolate bonbons. They show no wonder or admiration at persons and things, and are not affected by artistic furnishings, and their eyes are without expression.

A correspondent of Nature tells of some letters and papers on his desk which were set on fire by a paper weight composed of four glass balls. It concentrated the rays of the sun upon them. The desk was scorched, and the burning papers, falling upon the carpet, burned that.

Two instances of what may be called "dust photographs" are described in Nature by W. B. Croft, of Winchester College. The plate-glass window of a hotel in London has on the inside a screen of ground glass, near but not touching, on which are the words "Coffee Room" in clear, unfrosted letters. One day, as Dr. Earle, the writer's informant, was at breakfast, the screen was taken away, but the words were left plainly visible on the window, and no washing would remove them. In another case the house had been a hotel, and the windows had been dressed with brown gauze blinds, bearing the words "Coffee Room" in gilt letters. A succeeding tenant on misty days saw these words on one of the windows.

The results of six months' observations of Mars have led Mr. Schacherle, of the Lick Observatory, to the conclusion—contrary to the generally received view—that the dark portions of the disk represent land, and the light portions water. This is supported by observations of San Francisco Bay from Mount Hamilton, in which the bay appears brighter than the neighboring valley and mountains at the same distance. On this hypothesis the "canals" would correspond to ridges of mountains almost wholly immersed in water, while their doubling may represent parallel ridges of which our own earth furnishes examples.

The dangers of poisoning in the manufacture of white lead are avoided in a process introduced by Mr. J. B. Hannay, by which a sulphate of lead is produced instead of a carbonate. The pigment is made direct from the cheapest lead ore, which is crushed and fed into coke furnaces. The heat combined with an air-blast causes the lead to volatilize; the fumes are exposed to a current of steam, and the resultant creamy-white liquid mass is run off into settling tanks, whence it is passed into filter presses, deprived of its moisture, and dried and packed for market.

Some oysters experimented upon by Prof. R. C. Schiedt, under exposure, living, to light with the right valve of the shell removed, in the course of a fortnight developed pigment over the whole of the epidermis of the exposed right mantle and on the upper exposed sides of the gills, so that they became dark-brown all over that side. They also made a partly successful effort to restore the right valve. The inference is drawn from the facts that the development of pigment in the mantle and gills was wholly and directly due to the abnormal and general stimulus of light over their exposed surface, and that the mantle border, the only pigmented portion of the animal, is pigmented because it is the only portion which is normally and constantly subjected to the stimulus of light.

Attention has been called by Sir Henry Mance to the damage inflicted on electric telegraph cables by the teredo, which are described as being really serious, and the suggestion made by Mr. Preece several years ago is approved by the author, that, besides surveying the bottom of the sea for rocks and shoals, the parts near the shore should be examined to find whether they are infested by this pest.

In a paper published in Science, on Variability of Specific Characters in the Extinct Genus Coryphodon, M. Charles Earle shows that it is exceedingly difficult in this group to find where one species ends and another begins. In most cases the characters run into each other insensibly. The author believes that there are about eight good species, the characters of which show a progression from the primitive to the more specialized types. A later study by Mr. Earle is on the comparative osteology of the Malayan and the Brazilian tapirs.

During a residence in Tunisia, M. Vercoutre made a study of the tattoo marks with which the natives cover their limbs and face. He discovered that the most complete designs represent a human figure—a kind of doll, seen in front, with extended arms. In this figure, for which no explanation had been offered before, he perceives nothing else than a representation, rigidly exact and preserved by tradition without perceptible alteration, of the manikin on the monuments of Phœnicia and Carthage, which archæologists have named the "Symbol of the Punic Trinity"—which is found, for example, on the Phœnician and Punic stelæ, and on the neo-Punic lamps of Carthage.

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# WHY SILVER CEASES TO BE MONEY.

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THE striking fall in the price of silver and the unmistakable tendency among civilized countries to cease using it as a basis for currency, suggest the inquiry whether these results are accidental or flow from causes so regular and continuous in their application as to be analogous to physical law. Thirty years ago most economists would have hesitated little in seeking analogies of this sort. The general conclusions on which economists were then agreed were often stated to be natural laws, as certain and immutable in their application as the laws of the physical universe. The general rate of wages was governed by natural laws; prices were determined by natural laws, which combinations and speculators could not violate with impunity; monetary phenomena were subject to similar unalterable conditions. The value of the precious metals, like that of other commodities, was determined only by their cost of production, and legislative action seeking to regulate their value and bring about their concurrent circulation must of necessity be futile.

Of late the language even of conservative economists has been more guarded. The more ardent representatives of the new movement in economic thought go further, and reject once for all the notion of natural law in economic phenomena. Even those who appeal with confidence to economic laws must admit that their operation is in many ways unlike that of physical law. They are stated to be tendencies; they are conclusions hypothetically true, or true only in the long run. Above all, the play of human volition, and of legislation as reflecting

human volition, is admitted to be not the least of the forces that affect economic phenomena. Wages and prices may be affected by combinations on the one hand, and by legislation on the other hand; doubtless within limits, but within limits not so narrow nor so easily defined as was formerly thought. So the value of money is subject to legislation in no small degree. Paper money, though of the purest *fiat* character, with no hope or promise of redemption in specie, may yet perform with reasonable efficiency the functions of a circulating medium. No doubt the degree of effect is limited, and the expediency of particular forms of legislative action is more than doubtful. But the possibility of effect can not be denied. In granting so much, we may give aid and comfort to those whose proposals on the currency are mischievous; but truth, fairly faced, compels the admission that the value of money is not fixed by natural law in the sense that it may not be seriously affected by legislation. Looking to specie alone, it is clear that convention and legislation are at least the immediate cause of their high value. If gold ceased to be used as money, and if all the gold in the world were to be used in the arts only, it is beyond question that its value would fall, and would remain low for an indefinite time to come; while a great and sudden extension in the use of gold for monetary purposes, such as legislation might conceivably bring about, would quickly raise its value.

Coming now more closely to the subject in hand, and the question whether silver is likely to continue in use side by side with gold, we encounter the suggestion that silver is doomed from the operation of great and permanent causes operating with the force of natural law. Silver at best is bulky in proportion to its value. For transactions on a large scale it is inconvenient; and as it gets cheaper, a given value becomes bulkier, and the metal less available for the great transactions of modern commerce. Iron, copper, and other metals have been used in their day for monetary purposes, and with the progress of civilization have given way to the "precious" metals. As the further advance in wealth and progress brings the need of a medium of exchange by means of which large transactions can be conveniently carried on, must silver meet with a similar fate, and gold become the only standard monetary metal?

No doubt it is true that as coin, and for circulation in the form of coin, obstacles of this sort are serious for silver. As copper can be used only for very small payments, so silver can be used only for moderate payments. A striking illustration of the impossibility of using silver directly on a large scale is furnished by the experience of the United States under the silver act of 1878. That act provided for the monthly coinage and issue of a very large

number of silver dollars—on the average, two and a half millions a month—and the expectation of the legislature was, at the beginning, that these bulky coins would find their way into circulation and use. In fact, but a very small proportion of them ever came into actual use. Notwithstanding every effort of the Treasury to get the coins into circulation, the community stubbornly refused to make use of more than a small proportion of them. Some sixty millions were got into circulation; but the remainder of the four hundred millions which were coined lie unused in the vaults of the Treasury, and when issued by it flow back with a regularity and persistence not unlike the operation of natural law.

But the experience of the United States under this same act of 1878 suggests a very easy mode of surmounting this difficulty and of securing the actual and effective use of silver in indefinite quantity. The printing press and the engraver's art have revolutionized the situation. The silver certificates, which now form the largest single constituent in our every-day money, were issued, at first sparingly, later more generously, to represent the coined dollars and to circulate in their place. They are printed in any desired denomination; they are easy to carry; they circulate more freely even than gold coin. It is curious that this simple device should not have been thought of at the outset, and should have been evolved only after an experience, running through several years, of the impossibility of securing the circulation of the actual coins. But the lesson has been learned, and in the schemes for the free and unlimited coinage of silver dollars it is now always proposed that the silver shall indeed be freely coined, but that its actual circulation shall take place through certificates representing the deposit of the coined metal in the Government's hands. By a machinery of this sort any durable commodity may indeed become the basis of the monetary circulation, and the crucial question becomes not one of the possibility of the use of a commodity, but one of its expediency.

This leads us to another phase of the question, the inquiry whether silver possesses that stability in value which is admitted on all hands to be essential for money. If the price of silver, like that of copper and iron, is subject to great and rapid variations from changes in the conditions of production, it is inexpedient, even though possible, to make it the basis of the circulating medium. If the great decline in the price of silver in the last twenty years is due to causes like those which have brought down the price of copper and the price of iron, we have strong ground for refusing to use it further, except for subsidiary purposes like those for which copper continues to be used. But here it may be answered, and certainly with much show of reason, that the decline in the price of silver has been due largely to legislation. The civ-

ilized countries one after another have given up the use of silver, and by so narrowing the field for its use have caused a fall in price to take place which otherwise would have been averted. Germany gave up the use of silver, except for subsidiary purposes, in 1873. The United States dropped silver from her list of coins in the same year. France and the Latin Union virtually closed their mints to the free coinage of silver in 1874. Italy and Austria, in resuming specie payments—the one in 1883, the other in 1893—refused to adopt any but a gold standard. If in all these countries silver had been freely coined; if in Germany, France, the United States, and Austria, silver had retained the footing before the law which it had twenty-five years ago, the price undoubtedly would not have fallen so much, and the objection to its use from the fall in its price would certainly be much less strong than it is. Unquestionably, the great increase in the production of silver has contributed to bring down its price; but it is at least probable that the fall would have been less, and indeed that there would have been little fall, if any, in the gold price of silver if the mints of all those countries had remained open to silver as they were in 1870. Whether such a state of things would have been conducive to the general prosperity of these countries is another question. Looking merely at the point now under consideration—the cause and meaning of the lower price of silver—we must admit that legislation has been an important cause among those that brought it about.

We may go further with this line of thought, and consider how far it is possible that legislation might affect the price of silver in the future. If at the present time an effective international agreement were adopted for the wide use of silver as money in civilized countries, the price of silver undoubtedly would be raised for some considerable time. An agreement of the great countries, such as England, France, Germany, and the United States, for the free coinage of silver at a fixed ratio with gold would undoubtedly absorb much silver, would clear the market of heavy stocks, and would raise the price of silver in terms of gold to the point fixed by the international ratio. Such an agreement could hardly fail to bring about the concurrent circulation of silver and gold in the contracting countries, and to establish a real and effective bimetallism. How long this concurrent legislation would continue, and how long, even if the legislation continued, silver and gold would remain equal in relative value at the agreed ratio, are different questions. The future production of silver, the possible extended use of gold for other than monetary purposes, the probable increased use of gold in countries outside the international agreement, would very likely cause gold to disappear in the end from the contracting countries, and so would make silver the sole basis of their circulating

medium. But this result would not be brought about for a long time, measured by generations rather than by years. Certainly for a series of years international bimetallism, if adopted, would at least be not ineffective. No doubt all this is idle speculation, so far as any political probabilities are concerned. International jealousy, and a sufficient satisfaction in most countries with the existing state of things, make such an agreement impracticable. But this does not answer the question of principle, or show that the wider use of silver is restricted by any natural law. Doubts as to the expediency of the change and unwillingness to enter on hazardous legislation are the serious sources of difficulty for those who demand a free use of silver for currency.

The real question for the future of silver, then, is one of the expediency and possibility of legislation. It may be freely admitted that if legislation were different, the silver situation would be essentially different. And ultimately legislation will doubtless respond to the pressure of expediency. If it should appear that the exclusive use of gold works ill, that the failure to use silver causes mischief, and that the wider use of silver would make things better, we may expect that eventually the civilized countries, either by international agreement or by separate legislation, will retrace their steps and endeavor to secure the use of both metals. The fundamental question of expediency, again, is one as to the stability of prices and incomes. If under the gold standard there is a steady tendency toward lower prices and lower money incomes, and if such a decline works evil, there is ground for demanding a change. If, on the whole, the disuse of silver is accompanied by no mischievous changes, things may remain, and in all probability will remain, as they are.

So far as the experience of the past is concerned, it is not to be questioned that in fact there has been a general decline in prices since the date, roughly speaking, when silver began to be discarded and gold became the sole basis of the medium of exchange. The year 1873 brings at once the high-water mark of general prices and the beginning of the demonetization of silver. During the last twenty years wholesale prices and retail prices have steadily pressed downward. So far there is a *prima-facie* case for the proposition that it is gold that has appreciated rather than silver that has depreciated. But another equally striking and unquestionable phenomenon of the last twenty years has been that the money incomes of all classes of society have not gone down, but have rather tended upward. Such a movement, combined with the movement for lower prices, simply means that material prosperity has increased on all hands, that our income in terms of commodities is growing, and that men are getting more in return for their labor. Moreover, it is not to be

denied that on the whole and in the long run general prosperity has been great and wide during the last generation. The usual cycles of speculative activity and industrial depression have appeared, and at the successive periods of surface depression the cry has been raised that some unusual cause, like the demonetization of silver, was leading to general calamity. But the upward turn of the wave soon reappeared, and the growth of material prosperity, good years and bad years taken together, has not been interrupted.

Looking, too, at the relations of debtors and creditors, we find on the whole little to complain of. No doubt a period of simple rise or fall in general prices operates unjustly. When prices and money incomes rise, creditors do not get their dues; when they fall, debtors are subjected to a painful burden. But where we have the phenomenon of money wages and money incomes which are steady and on the whole probably increasing—and this is what the world has seen during the last generation—the situation approaches as near justice as is possible in things human. A debtor who borrowed five, ten, or twenty years ago has an undiminished money income, and can not be said to feel special hardship when he repays his debt, even though the prices of commodities may have decreased. That individual debtors and classes of debtors may have suffered is beyond question; but in the mass the situation has not given rise to general hardship.

Hitherto, therefore, the adoption of the gold standard, the drift toward restricting silver to use as a *quasi*-subsidiary coin, have not worked ill. Indeed, it may be said to have prevented ill, since the use of silver side by side with gold, in view of the enormous increase of the production of silver, in all probability would have disturbed seriously the stability of the monetary medium. What, now, of the future? Are the same tendencies likely to appear in years to come, and is the gold standard likely to work well in the future as it has in the past?

In answering these questions we must not refuse to face certain facts in the situation insisted upon by the bimetallists. The supply of gold available for monetary use is not likely to increase rapidly in the future. The production of gold has been nearly stationary for the past twenty years. In the last two or three years an upward movement has appeared; it remains to be seen, however, whether any permanent advance will be maintained. The use of gold in the arts is apparently increasing, and is likely to continue to increase; and it absorbs a growing part of the annual supply. Meanwhile the wealth and population of civilized countries are advancing rapidly. If stability in money affairs is to be secured, some steady increase in their circulating medium must be provided for. If we regard gold coin alone, and

consider the development of the currency to be limited to the coin or to be in exact proportion to the coin, the situation may be fairly described as ominous. There would be ground for saying, as men of science have recently done,* that eventually the gold standard will become untenable, and that silver will force its way into use side by side with gold, if not to the exclusion of gold.

But the situation is modified, if not transformed, by another factor in present and in future industrial history: that development of credit machinery which forms the most striking phenomenon in the monetary history of modern times. In the development of credit as a substitute for money we have something like a natural law, which will put to naught the predictions of those who predict disaster from the failure to make wider use of silver. If, indeed, coin money were the sole or the most important constituent in the medium of exchange in civilized communities, silver or some other metal must certainly be brought in to supplement the scanty growth of the supply of the gold. In fact, however, the actual currency of civilized countries tends to consist less and less of specie, more and more of credit substitutes for specie. Bank notes, government notes, and above all bank checks, actually perform the commercial transactions of civilized countries. Specie is the basis of exchange; it is the measure in terms of which the value of commodities is expressed; but it is only to an insignificant extent the medium by which exchanges are actually conducted. The use of credit is of course most highly developed in countries like the United States and England, which lead the world in general industrial development. It is growing steadily and surely in continental Europe, and, beyond question, will continue to grow. Each individual, each financial institution, each government, is tempted to enlarge the scope of credit operations and to diminish the use of actual coin; and the steady pressure of these motives makes the tendency as sure and unalterable as physical law.

That this tendency brings its dangers can not be denied. An ever-increasing volume of credit is based upon a relatively smaller foundation of specie, and the evils of a sudden impairment of credit become more and more serious. It has been attempted to obviate the dangers by enlarging the basis of specie; and the wider use of silver is advocated as one method of broadening the substructure. But efforts in this direction are likely to have but temporary results. A broader basis of specie is likely, under the influence of the same forces which now lead to an extended use of credit, to bring about in due time an expansion of credit machin-

* See Die Zukunft des Silbers, by Eduard Suess, Vienna, 1892.

ery in some way proportionate to the enlarged foundation on which it rests. After a brief respite the difficulties which it was proposed thus to obviate will reappear with undiminished intensity. The surer method, and that which is developing under the stress of need and the growth of experience, is to strengthen the foundation rather than to enlarge it. The specie which serves as the basis of the swelling volume of credit transactions is massed in fewer hands, and so is made more effective in sustaining the superstructure. The great public banks of European countries are guardians of the treasure which gives tone to their currency and serves as the standard for transactions in which it is used to less and less extent in bodily shape. The central stock which serves the same purpose in the United States is held, not by a semi-public institution to whom the duty has been delegated, but by the Federal Treasury directly. Its amount has been seriously lessened of late, and may be subject to further drain in the immediate future. But there are no indications that the supply of gold obtainable for this purpose is inadequate, in the United States or in the world at large, to serve the uses likely to be made of it in the future. Our own reserve should be enlarged; and there can be little doubt that the community, once aroused to the situation, will not permit it to shrink to the point of real danger.

So far as the visible future is concerned, we may therefore look to the maintenance of the gold standard by all the great civilized countries. Silver will be used for subsidiary purposes to some extent in all advanced countries, and apparently to a very large extent in the United States. But silver will not again become standard money, freely coined for all holders. It will have to seek its market, partly for use in the arts, partly for subsidiary purposes as money in the countries of advanced civilization, partly for more or less complete monetary use in regions like India, China, and South America. Within the last two months the British Government in India has taken a step of far-reaching consequence, in suspending the free coinage of silver in that country. The step is not definitive, and it remains to be seen what policy will finally be adopted. Whatever may be done, a considerable flow of silver to India is likely to continue in the future; the market for the metal there has by no means been wiped out. But the conditions under which silver can be disposed of must be seriously affected by the cessation of unlimited coinage in the country in which alone very large quantities found their way into permanent monetary use through a free mint. The new move, moreover, whatever its effect may be on the quantity of silver which will actually find its way to India, must in any case have an important effect on the future of silver in its political aspects. It wipes out the possibility of free coinage of silver in

the United States; it makes highly probable the diminution or cessation of large silver purchases by the United States. The grounds of expediency against making silver the standard of value, or so legislating that it may possibly become the standard of value, have become stronger than ever.

What the price of silver will be in the future must depend on the volume of the annual production as compared with the occasion for its employment in the several ways just mentioned. The crucial question is that of production. During the last twenty years the world's production of silver has more than doubled. Geologists tell us that this great increase has been due to an extraordinary succession of lucky finds, not likely to be repeated; and they predicted, even before the collapse in the price due to the action of British India, that silver would be produced in smaller quantity in the future. Predictions on this subject, even from the most competent men of science, are to be accepted with caution, and it remains to be seen what the future will bring. Those old mines or newly discovered bonanzas which can produce silver at very low cost will continue to turn it out, even though a mixed feeling of panic and bluster may have caused them for the moment to stop operations. Mines which have been working at a moderate profit or none at all will one by one cease, now that the prospect of a rise or even maintenance of the price of silver has become so desperate. The gambling character of the business makes it difficult to use the reasoning which would apply to most industrial operations; but apparently we may look for some diminution of production. If this occurs, silver may maintain something like its present value, and the commercial relations between gold-using and silver-using parts of the world will gradually adapt themselves to the new basis. If production continues at anything like its present rate, still more if it augments, no one can tell what may happen to silver. Its price may fall indefinitely, and in the end it may disappear from monetary use as completely as copper has done. But a diminution of production and of the quantity of silver finding its way to the market seems the more probable outcome; and with this a price at a permanently lower level than ever in the history of the world until within the last twenty years. In either case silver ceases to be the basis on which the countries of advanced civilization rest their monetary systems: not so much from its physical unfitness, as from the increasing use of a more refined and highly developed medium of exchange, needing for its foundation a moderate supply of specie having a stable and uniform value.

# FOLK-LORE STUDY IN AMERICA.

By LEE J. VANCE.

IN the summer of 1887 a circular letter containing a proposal for the formation of a Folk-lore Society in America was quietly, perhaps timidly, sent to a faithful few. Again, in October of the same year was issued a second letter, subscribed with a hundred and four names, representing different parts of the United States and Canada. Briefly stated, it was proposed to form a society for the study of folk lore, of which the principal object shall be to establish a journal of a scientific character designed—

1. For the collection of the fast-vanishing remains of folk lore in America—namely, (*a*) relics of old English folk lore (ballads, tales, superstitions, etc.); (*b*) lore of negroes in the Southern States; (*c*) lore of the Indian tribes in North America (myths, tales, etc.); (*d*) lore of French Canada, Mexico, etc.

2. For the study of the general subject and publication of the results of special students in this department.

The outcome was that, on the 4th of January, 1888, a goodly number of persons interested in folk-lore study assembled in University Hall, Harvard University. Then and there The American Folk-lore Society was born and baptized. Prof. Francis J. Child was chosen president, an honor merited by his long and splendid service in the field. Fourteen persons were named as a council to conduct the affairs of the new society. Mr. William Wells Newell was elected secretary. At the same time a committee, consisting of Prof. T. Frederick Crane, Dr. Franz Boas, Rev. J. Owen Dorsey, and the secretary, was appointed to make arrangements for the publication of a journal.

The first number of the Journal of American Folk Lore made its appearance in April, 1888. The five volumes already issued are ample evidences of the wealth of popular traditions in this country. They form a perfect mine of information for the study of folk lore. The contributions which have been printed in the Journal touch on almost every side of the subject. They include myths and tales of the Indians, negroes, and creoles, strange and curious customs, superstitions of all kinds and all shades, beliefs in witches and goblins, queer practices, magic and divination, songs, dances, games, nursery rhymes, riddles, wise saws, and dialect words.

Few persons, even those who were directly interested in the study, had any adequate idea of the body and bulk of folk-lore materials extant in North America. First in quantity and quality come the collections of the lore of the Indian tribes. This, of course, was to be expected. The contributions by Prof. Hale, Dr. Boas, Mr. Beauchamp, Rev. J. Owen Dorsey, Mr. Chamberlain, Dr.

Mathews, Captain Bourke, Dr. Fewkes, Mr. Mooney, Dr. Brinton, Miss Fletcher, and others have been noticed by Prof. Frederick Starr in his article on Anthropological Study in America.*

Perhaps the most striking results have been obtained in fields heretofore unvisited and unworked. We refer particularly to the lore found within the past four or five years among foreign-born and English-speaking peoples, both in thickly settled districts and in out-of-the-way places. Dr. Hoffman's collection of the folk lore of the Pennsylvania Germans; Prof. Fortier's account of creole customs and superstitions, together with his versions of creole nursery tales; Mr. Mooney's and Miss Hoke's articles on the folk lore of the North Carolina mountain region; Mr. Culin's paper on Chinese customs and superstitions in Philadelphia and New York; Mr. Henry Lang's account of the Portuguese element in New England; Mrs. Bergen's and Mr. Newell's studies of current superstitions in different sections of the United States—these contributions, to name no others, show that emigrants to America, if they did not bring much material wealth, certainly carried with them what Carlyle calls "old clothes philosophy." Every number of the Folk-lore Journal has been a revelation to its many readers. We predict that greater surprises than those already given are in store for us.

Prof. Francis J. Child.

The greatest progress in folk-lore study in this country has been made within the past six years, and it is significant to note that the Folk-lore Society has grown during the same time. Prior to 1887 the study of popular tradition in America was unorganized. Since then the investigations of special students in different fields have been collated and systematized, and, above all, those interested in the subject have been brought together. Thus to-day there is a certain *esprit de corps* among American folk-lorists that was unknown some six or eight years ago.

* In The Popular Science Monthly for July, 1892.

Naturally the new society has had to do quite an amount of missionary work. What our folk-lore scholars are "driving at," the importance of the study of unwritten traditions, the value of Indian myths and rude customs, of negro fables, or of old superstitions, the great necessity of gathering the lore of American folk while there are time and opportunity—these are matters that the general public do not yet fully understand or appreciate. Folk lore is a study to which every one can add his or her mite, from the farmer to the stock broker, from the servant girl to the mistress. We find many quaint and curious items of superstition or traditionary lore in the parlor, in the kitchen, and in Wall Street. Indeed, we need only to read the daily newspaper reports of clairvoyants, mediums, fortune-telling, haunted houses, etc., to be reminded of those low forms of thought that characterize rude and uncivilized communities.

The American Folk-lore Society has continued to increase in numbers from the very beginning. It now has a membership of five hundred, which exceeds that of any similar organization in Europe. The influence of the society has been strengthened and extended principally by the formation of branch societies in different sections of the country. There are now folk-lore societies in six large cities—in Boston, Philadelphia, New Orleans, Montreal, Chicago, and New York. The Chicago Folk-lore Society is an independent body; the others are affiliated with the national society.


Mr. W. W. Newell.

The effect of these local societies on the future study of folk lore in America can not be estimated at the present time. Already their influence has been felt in many quarters. The meetings bring people together for an interchange of views and for pleasant entertainment. Although these societies have a social side and function, they are in fact working societies, as the following will show:

The first local branch of the American Folk-lore Society was established in November, 1889, at Philadelphia—a city noted for

the number of persons interested in the study.* The stated meetings of the chapter are held on the second Wednesday of the month from November to June. Many carefully prepared papers have been read at the meetings, and some of them have been printed in the Journal. Among these we may mention Miss Alice C. Fletcher's able address on Child Life among the American Indians; Mrs. de Guerrero's paper on Games and Popular Superstitions of Nicaragua; and Mr. Stewart Culin's interesting remarks on Children's Street Games.

PROF. ALCÉE FORTIER.

The Folk-lore Museum established in connection with the Philadelphia chapter is unique. Many rare and valuable objects have been collected and are deposited in the Museum of the University of Pennsylvania. These objects serve to illustrate myth, religion, custom, and superstition the world over. The collection includes idols and ceremonial objects from China, Japan, India, Thibet, Egypt, Polynesia, Africa, North and South America. Prominent in this exhibit are amulets and charms of paper and wood and metal. Very interesting are those implements used for divination and fortune-telling and those manipulated in games. Thus, the evolution of the playing card is shown; so too the games of chess and backgammon are displayed in their various forms or types. Nor have the games and toys and dolls of children been overlooked. They are all there—even Noah's ark, with its beasts and birds, two and two. Such a museum is an "object lesson" in folk lore.†

Several informal meetings of persons living in Boston and its

* The following officers were chosen: President, Mr. Victor Guilloû; secretary, Mr. Stewart Culin; treasurer, Mr. J. Granville Leach; librarian, Mr. John W. Jordan, Jr.; committee, Messrs. Richard L. Ashurst and Francis C. Macaulay, and Mrs. Cornelius Stevenson.

† It may not be amiss to call attention to the exhibition of folk-lore objects at the Columbian Exposition in Chicago. It forms part of a section of the Department of Ethnology and Archæology of the Exposition. There will be also an anthropological library and a display of the current numbers of folk-lore journals throughout the world.

vicinity were held during 1888-'89. But it was not until March, 1890, that "The Boston Association" of the American Folk-lore Society was organized.* The meetings are held once a month, from November to June, in the rooms of the Boston Natural History Society or at private houses.

The activity of the Boston Association has been considerable. Some pleasant features have been introduced into the proceedings in order to give variety to the study in which the members are interested. In 1891 a performance was held, under the auspices of the association, at the Chinese theater. Last winter an entertainment was given under the name of "The Japanese Dance." The dances presented histories or the phenomena of Nature, displayed by gesture and motion; thus, *Harusame* (the Dew of Spring) showed the falling of dew on flowers; *Sedogahataki* (the Vegetable Garden), a humorous dance, illustrating the gathering of pumpkins and the tripping over the vines; *Goshorasuma* illustrated how a maiden received her first love-letter, and so on.

Prof. D. P. Penhallow.

The Louisiana Association of the American Folk-lore Society was organized in December, 1891, at New Orleans.† The number of members is fifty. The meetings of the association are held in the library of Tulane University and at private residences, and they have been exceedingly profitable and agreeable.

The members of the Louisiana Association have a grand chance to make their work known and felt. They are at home in one of

* The following officers were chosen: President, Mr. Frederick W. Putnam; vice-presidents, Miss Abby L. Alger, department of Algonkin folk lore; Clarence J. Blake, folk music; Prof. Francis J. Child, English folk lore; Dana Estes, literature and publication; Miss Mary Hemenway, Zuñi folk lore; Colonel Thomas W. Higginson, Southern folk lore; secretary, W. W. Newell; treasurer, Arthur G. Everett.

† The officers of the association are: President, Prof. Alcée Fortier; vice-president, Mrs. Mary A. Townsend; secretary and treasurer, Mr. William Beer; assistant secretary, Edward Forster; executive board, Mrs. Francis Blake, Mrs. M. E. Davis, Mrs. George Howe, and Colonel William Preston Johnston.

the most promising fields of folk-lore exploration in the United States. There has been a strange mingling of races in Louisiana. The result is that relics of the voodoo or obi rites, conjurings, magic, medical superstitions, fables, plantation songs, and religious notions of the negroes linger on side by side with the superstitions, ghost stories, omens, charms, nursery tales, and rhymes brought by the whites from Europe. The quaint dialects of these settlers offer an inviting field of study which should not be overlooked.

The Louisiana Association has given an impulse to folk lore study in the State, and it has resulted in the collection of many stories and superstitions current among the creoles and negroes "before the war." The ladies have contributed many items of traditionary lore. Mrs. Preston Johnston, Mrs. Mason Cooke, Mrs. C. V. Jamison, and Mrs. M. E. Davis have written out stories told to them in childhood by their negro nurses. The folk lore of French Louisiana has been collected by Prof. Fortier during the past twenty years. Some of this valuable material has appeared in the Folk-lore Journal, and some of it, entitled Bits of Louisiana Folk Lore, was printed in the Transactions of the Modern Language Association for 1887. Thanks to American scholarship, not to American liberality, the complete work of Prof. Fortier will be issued shortly, as the second of a series of monographs of the American Folk-lore Society.*

MISS ALICE C. FLETCHER.

It is with pleasure that we record the establishment of a society for the study of folk lore in Canada. The formation of the Montreal branch was due largely to the diplomatic efforts of Prof. D. P. Penhallow and Mr. John Reade, who soon had the cordial sympathy and support of many Canadian students, among whom

* The American Folk-lore Society is about to begin a series of Memoirs. The first of these will consist of a collection of Folk Tales of Angola (Africa) by Mr. Heli Chatelain. The connection of West African folk lore with that of American negroes brings the material within the field covered by the society, and should excite much interest.

we may name Hon. H. Beaugrand (ex-Mayor of Montreal), Dr. Louis Fréchette (*lauréat* of the French Academy), Mr. W. J. White, Mr. Henry Carter, Dr. Robert Bell, F. G. S., Dr. Beers, Dr. Le May, Dr. Kingsford, F. R. S. Can., and Dr. S. E. Dawson, Queen's printer. Several informal meetings were held during the winter of 1892, and in April of that year a permanent organization was effected.* The membership roll shows a list of about sixty names. Many interesting papers have been read at the meetings, and the social element has been combined with serious study in a most delightful manner.

It is hardly necessary to call attention to the opportunities for the study of folk lore in Canada. This has been done by Mr. Reade in a very suggestive paper read before the Montreal society.† We need only refer to the mingling of races in Canada. The Indian tribes of the Northwest; the descendants of the pioneers of French Canada, of the loyalists, and of the Scotch, Irish, English, and Germans; the scattered settlements of Russians, Hungarians, Norsemen, Chinese, etc., in western Canada—these folk afford as rich field for inquiries of the folk-lorist as he or she would desire. Some curious items of superstition, or traditionary lore, found in the provinces, have been collected, but much remains in the mouths of the folk, the plain people in country towns and districts. Meanwhile a series of investigations relating to the Indian tribes of the Northwest are going on under the auspices of the British Association for the Advancement of Science, aided by the Canadian Government.

The New York branch of the American Folk-lore Society was organized in February of this year.‡ The membership at the first meeting was about forty; it is now double that number. The metropolis has become the stamping-ground for representatives of all the nations of the earth. There are old-fashioned people as well as Huns and Vandals in New York. The right person will find plenty of folk lore in the "quarters" of the Italians, Poles, Jews, Czechs, Hungarians, Chinese, etc. Within a radius of one hundred miles around the city there are settlements that would furnish the material eagerly wanted by the Folk-lore Society.

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* The officers of the Montreal branch of the American Folk-lore Society for 1893 are as follows: President, Prof. D. P. Penhallow, McGill University; vice-presidents, M. Louis Fréchette and Mr. John Reade; secretary, Mr. F. E. Came; treasurer, Mr. W. J. White; ladies' committee, Mrs. Robert Reid, Mrs. L. Fréchette, Mrs. H. B. Ames, Mrs. K. Boissevain, Miss Macdonnell, and Miss Van Horne.

† Published in the Dominion Illustrated Monthly for June, 1892.

‡ The officers of this branch are as follows: President, Dr. H. Carrington Bolton; first vice-president, Mr. George Bird Grinnell; second vice-president, Mr. Richard Watson Gilder; secretary, Mr. William B. Tuthill; treasurer, Mr. Sydney A. Smith; ladies' committee, Mrs. Henry Draper, Mrs. Harriet M. Converse, and Mrs. Mary J. Field.

The other day Dr. Bolton found an intelligent, skilled workman in the metropolis, who used the magic mirror (the Urim and Thummim of the ancient Jews) for the purposes of divination. The seer made use of the Urim to guide his daily life, and to consult with the spirits of many distinguished persons from whom he received communications. Dr. Bolton found also a fruitful field of inquiry in the counting-out rhymes of children.* Another member of the New York branch who has contributed to our slender stock of knowledge concerning the Pawnee and Blackfeet Indians is Mr. George Bird Grinnell. He is at home with these "prairie people," as they are called. He has lived, slept, camped, hunted, and "swapped stories" with them. His collection of Pawnee Hero Stories and Folk Tales showed what other travelers had missed. Mr. Grinnell is by adoption a member of the Blackfeet tribe, and his book of Blackfoot Lodge Tales tells the life of a Blackfoot brave from infancy to his departure at death to the Sandhills—the happy hunting ground of the tribe. Among other members of the New York branch we may mention the work of Mrs. Harriett Maxwell Converse, who is by adoption a member of the Seneca tribe, and Mr. De Cost Smith, who has written and sketched cleverly the ceremonies of the Onondagas.

Mr. George B. Grinnell.

The Chicago Folk-lore Society is an independent organization, not a branch of the American Folk-lore Society. This society was organized in December, 1891.† The membership of the society numbers now about eighty persons, with about twenty

* The Counting-out Rhymes of Children: their Antiquity, Origin, and Distribution. A Study in Folk Lore. New York: D. Appleton & Co., 1888.

† The officers for the year 1893-'94 are as follows: President, Prof. William I. Knapp; vice-presidents, Captain E. L. Huggins, United States Navy, department of Sioux and cognate tribes; Rabbi E. G. Hirsch, Semitic folk lore; Prof. Frederick Starr, Dr. Washington Mathews, Indian tribes of the Southwest; Mr. George W. Cable, Southern folk songs; secretary, Lieutenant Fletcher S. Bassett, United States Navy; treasurer, Miss Elizabeth Head; directors, Mrs. Fletcher S. Bassett, Mrs. Potter Palmer, and Mrs. Edward E. Ayer.

non-resident members. A manual for the use of members has been prepared by Lieutenant F. S. Bassett, and it contains many practical observations and suggestions for collectors. The Chicago society publishes a quarterly journal called The Folk-lorist, edited by Lieutenant Bassett and Mrs. Bassett, both of whom deserve credit for promoting the organized study of folk lore in Chicago. The contribution on Illinois Folk Lore, by Miss Helen M. Wheeler, shows what the right person can do in the State outside of the cities. Many of the superstitions of the pioneers of the Western country have disappeared, but the traditional customs and beliefs of their descendants, if closely studied as they have been noted by some American novelists, should yield unexpected results.

Colonel Charles C. Jones, Jr.

The meetings of the Chicago Folk-lore Society are held once a month at the Woman's Club Rooms. They have been very interesting and well attended. Some idea of the useful work done may be gained from the programme presented at the meeting in April last. The guests of the evening were Mrs. French-Sheldon, the African explorer, and Captain John G. Bourke. There were contributions by Mrs. Molly Eliot Seawell, Miss Mary A. Owen (the author of a book of Voodoo Tales), Mrs. Eva Wigstrœm, of Sweden, Mr. A. M. Stephen, and Prof. H. Hurlburt. The readers were Major Joseph Kirkland, Mr. Franklin H. Head, Captain E. L. Huggins, and Mrs. Wilmarth.*

This completes the list of local folk-lore societies in America. It is expected that one or two new branches will be established before another year. There should be folk-lore societies in fields

* The Chicago Folk-lore Society has adopted a seal and motto—an idea which might be used by the other societies. The figure in the seal represents the meal-sprinkler of the Navajos—the courier sent out by the priest during the ceremonies of the "Mountain Chant." The motto on the seal is the well-known line from Hiawatha—"Whence these legends and traditions." (Dr. Mathews's account of the ceremonies in Report of the Bureau of Ethnology for 1883–'84.)

in which opportunities to gather valuable material are found: for example, in the Pennsylvania coal fields, where Hungarians congregate; in the Southwest, where the negroes and "poor whites" touch elbows; in the Northwest, where the Scandinavians are numerous; and on the Pacific coast, where Indians, Chinese, and half-breeds mingle.

A few words as to the work of the officers and leaders of the national Folk-lore Society.* The honor of holding the presidency rightfully belongs to Prof. Horatio Hale, whose studies date back to a time when the term "folk lore" could not be found in Webster's Dictionary. His first important contribution was to the volume of Ethnography and Philology of the United States Exploring Expedition under Wilkes (Volume VII). Then Prof. Hale increased his reputation by editing The Iroquois Book of Rites.† This Iroquois book is almost pure folk lore, and has a special interest, as showing how authentic history can be derived from popular tradition where this has been handed down in public and solemn recitations. To this evidence alone we owe the establishment of the fact that Hiawatha was not a mythical hero, but an actual Onondaga chief, who lived between four and five centuries ago, and helped to form the great Iroquois Confederation. For further information on the story of Hiawatha, see Mr. Beauchamp's scholarly paper entitled Hi-a-wat-ha, in the Journal of American Folk Lore (for 1891, p. 295).

The man who is responsible for the very existence of such an organization as The American Folk-lore Society is William Wells Newell. He it was who issued the call to arms, who drafted the circular letter already referred to, who put the new organization in line with the great anthropological movement in America, who has generously given his time and services to the cause of folk lore; who, in short, has been the general executive officer of the society from the beginning. All this has been a labor of love with our honored permanent secretary. Mr. Newell won his reputation as a folk-lorist by his book of Games and Songs of American Children (1883). Since then he has contributed to the Journal of American Folk Lore a large number of valuable papers, which we all hope to see some day within the covers of a book.

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* The officers of the American Folk-Lore Society for the year 1893 are as follows: President, Horatio Hale, Clinton, Ontario; first vice-president, Alcée Fortier; second vice-president, D. P. Penhallow. Council, Franz Boas, H. Carrington Bolton, D. G. Brinton, A. F. Chamberlain, J. Owen Dorsey, Alice C. Fletcher, George Bird Grinnell, Otis T. Mason, and Frederick W. Putnam. Permanent secretary, William Wells Newell, Cambridge, Mass.; corresponding secretary, J. Walter Fewkes; treasurer, John H. Hinton, M. D.; curator, Stewart Culin.

† It forms No. 2 of Brinton's Library of Aboriginal American Literature, Philadelphia, 1883.

A clever writer in The Saturday Review (whom we suspect to be none other than Andrew Lang) begins his book review with two sentences which deserve to be quoted at this place.* He says: "(1) It is not very much to our national credit that an American, Prof. Child, is making far the best edition of our ballads. (2) Nor is it very much to the credit of Ireland that an American has made much the most interesting collections of her old popular tales." Prof. Child's monumental edition of English and Scottish Popular Ballads represents the best years of his life. It is a veritable mine of comparative folk lore, to which scholars will go again and again, and all will come away richer and wiser after their visit.

The American referred to in the second sentence above quoted is Mr. Jeremiah Curtin, a member of the Folk-lore Society. His collection of the Myths and Folk Lore of Ireland should make every lover of old Ireland his friend. Mr. Curtin gained his training and experience in collection of our Indian myths. He has published recently a collection of Myths and Folk Tales of the Russians, Western Slavs, and Magyars (1890), in which his singular ability as a collector and interpreter of popular tradition is again displayed. Another member of the Folk-lore Society, Mr. James Mooney, went over to Ireland with the purpose of studying the traditions of his ancestral county. His account of The Holiday Customs of Ireland is a remarkably fine bit of work.† Mr. Mooney's special work has been under the auspices of the Bureau of Ethnology. His examination of the theory and practice of medicine among the Cherokee Indians is a masterly presentation of an obscure and complicated folk practice.‡

The study of negro lore has been the means of making the reputation of at least one American writer. We refer of course to Mr. Joel Chandler Harris, to whom will always be given the credit of making the lore of the plantation interesting alike to the student and the general reader. His Uncle Remus Tales have a scientific worth, aside from a literary value. In his Negro Myths, Colonel Charles C. Jones has done for the dialect and folk lore of the negroes of the Georgia coast what Mr. Harris did so wonderfully well for the legends of the old plantation of middle Georgia. The stories of Daddy Jack and Daddy Sandy are on a par with the tales of Uncle Remus. But there is a difference in the lingo of the negroes; the darkies of the Georgia rice-fields and swamp region have almost a different language from that of the colored folk of Maryland or of Tennessee.

* For April 12, 1890.

† Published in the Proceedings of the American Philosophical Society, 1889.

‡ In the Journal of American Folk Lore, 1890; also Bureau of Ethnology, 1885–'86.

It did not take Prof. Crane long to make the interesting discovery that the fables and "yarns" of Uncle Remus were parallel to stories Prof. Hartt heard from his guide on the Amazon River, to stories collected by Dr. Bleek in South Africa, and to popular tales in Europe. He was able to trace the majority of the Legends of the Old Plantation to their foreign variants.* Prof. Crane is our acknowledged authority in the field of storiology. He first published a charming collection of Italian Popular Tales, with a scholarly introduction and elaborate notes. His able paper on Mediæval Sermons, Books, and Stories was followed by a critical edition of The Exempla, or Illustrative Stories from the Sermones Vulgares of Jacques de Vitry, published by the English Folk-lore Society in its series of memoirs (1890). Jacques de Vitry was an eloquent and popular bishop of the thirteenth century, who made great use of apologues, or *exempla*, in his sermons, with the express purpose of instructing and sometimes of amusing his audiences. These illustrative stories were diffused over all Europe, and some of them have won their way into literature—have reappeared now in the fables of La Fontaine, and then in the plays of Molière and Shakespeare. Prof. Crane has published recently an edition of Chansons Populaires de la France, a selection from French popular ballads.

Prof. T. Frederick Crane.

Thus far the work of American folk-lorists has been directed almost entirely to the collection of material to be collated and examined afterward according to scientific methods. American students think that the time has not yet come for theoretical discussions, such as English and Continental scholars have waged so sharply at times and without good cause. Nor are they ready yet to favor the establishment of a separate science of folk lore. In the Handbook, issued by the authority of the English Society, it is stated that "the definition of the science of folk lore, as the so-

* Prof. Crane's study appeared in The Popular Science Monthly, April, 1881.

ciety will in future study it, may be taken to be as follows: the comparison and identification of the survivals of archaic beliefs, customs, and traditions in modern ages." So far, so good.

But the truth is that the exact definition of the term "folk lore" is still a matter in dispute. The proper place of the "science of folk lore" remains to be settled. Thus there will be two folk-lore congresses at the World's Columbian Exposition: one congress to be held in the month of July, in connection with the Department of Literature; the other Folk-lore Congress to be held in August, with the Congress of Anthropology. There is no department of comparative folk-lore in any college or university.

Finally, we attribute the rapid progress and popularity of folk-lore study in America and in Europe to three reasons: (1) Folk lore is a study to which almost every one can contribute something; (2) folk lore is a study which throws a flood of light on man's past mental evolution and culture-history, as the Germans call the study; (3) folk lore is a study in which the student of religions, the student of morals, the ethnologist, the antiquarian, the psychologist, the historian, the poet, and the *littérateur*, each finds a different interest and a different value.

## REFORMATORY PRISONS AND LOMBROSO'S THEORIES.

By Miss HELEN ZIMMERN.

In no branch of social science has so much progress been made of recent years as in the treatment of the criminal. Mankind in general has at last come to recognize what Sir Thomas Moore knew long ago, that the end of punishment is "nothing else but the destruction of vices and the saving of men." The prison has become, and rightly, a moral hospital. Whether, however, we are not now inclining to err a little too much on the other side in our latter methods of prison treatment is a question that is exercising the general public as well as criminal anthropologists and professors of legal medicine. Are we not perhaps encouraging rather than deterring crime by our present tendency to prison philanthropy? Do we not tend to make prison too pleasant a place, so that those who have been there are apt to sing in an irreverent spirit the words of the hymn that telleth—

> "I have been there, and fain would go;
> It is a little heaven below"?

Is it no longer good, as the gospel teaches, that the transgressor's way be made hard lest a worse evil befall?

On all these points there is unquestionably no greater authority in the world to consult than Prof. Cesare Lombroso, Professor

of Forensic Medicine at the University of Turin, who may be regarded as the inaugurator of the modern science of criminal anthropology, the thinker whose work on Criminal Man (L'Uomo Delinquente) had, on its appearance in 1889, an influence as decisive as had in its day the publication of Darwin's Origin of Species. In the vexed question that is now waging as to the treatment of criminals, in which we find ranged on one side men like W. Z. Brockway, of the Elmira Reformatory, and on the other an authority such as Mr. William Tallack, of the Howard Association, a society that bears the name of the great English prison philanthropist and exists for the purpose of alleviating the malefactor's pain, it is well to go to the fountain head and hear what Lombroso has to say on the point.

Now, Lombroso starts from the premise that a reason must exist why certain men are impelled by their very nature to commit crimes, and that hence there must be a difference in their very organism sufficiently marked to distinguish normal men from those morally or mentally mad. In the various medical clinics numerous and minute psychiatric observations, calculations of the most insignificant abnormities in the eurythmia of the human body, confrontation and establishment of mathematical data, have all combined to advance the science of criminal anthropology, so that it has become possible to divide mankind into three great principal classes—normal men, criminal men, and madmen. Now, Prof. Lombroso, from his own experience and that of the scholars who work under his direction—many of whom, like Prof. Enrico Ferri, have become almost as prominent as himself—had come some while ago to the conclusion that an absolute reform is required in the old methods of criminal punishment, and the first thing to do was to distinguish with great care the congenital criminal from the madman. The professor condemns rigorously the carelessness with which the legal tribunals pronounce sentences, and points out with much acumen that inconvenience, not to say irreparable harm, is thus done, mischief that always accrues to the detriment of those who perform their duty, and who surely have a right to be protected by the state. Hence, says Lombroso, it is above all others the magistrate who should pursue the study of criminal anthropology, because while every one of those who have had contact with malefactors, such as the members of their own family and prison directors, regard them as men different from others—that is, persons of weak mind or almost insane, and never, or at least hardly ever, susceptible of improvement; while the psychiatrist finds it impossible in most cases to distinguish clearly between madness and guilt, the legislator, on his part, rarely gives heed to the acute criticisms of the alienist, to the timid objections of the prison officials. As a rule,

magistrates hold that the cases are rare, nay, indeed exceptional, in which the criminal is subject to distorted volition, and but too frequently deem a jurist's highest earthly mission to consist in laying down his legal judgments, which start from hard and fast rules and admit of no gradations between the sane, the alienated, and the criminal mind. Hence this type of lawgiver has one sole idea, one single starting point, in assigning his verdicts. He has but one *régime* of punishment to bestow on each individual crime, and this is pronounced without preoccupying himself concerning the divergences of climate, region, and habit whence the crime has sprung. He judges the minds of others by his own, which has probably been nourished on the most sublime speculations of human wisdom. Hence, legal philosophers and legislators will not, and perchance can not, descend from the proud heights of metaphysics to the humble and arid territory of penal establishments. Their opinions on these points are, therefore, almost valueless.

In a letter recently addressed to me, in reply to my query of how he would treat the criminal, and what he thought of the Elmira system, Prof. Lombroso replied:

"To put it briefly, my idea is that so far all we have done is mistaken, not excluding from this condemnation the American reformatories. I hold that for women, for instance, except in quite a few cases (perhaps twenty or thirty, speaking of Italy), there is no need for prisons. A species of convent would suffice. For young men it is necessary first of all to distinguish the congenital criminals from those who are sons of parents affected by syphilis, or alcohol, or typhus. Then, accordingly, they should be submitted to treatment, but not a commonplace one like that of Elmira, but be dosed with homœopathic sulphur, nux vomica, or submitted to electricity. If, after such a cure, they show no signs of improvement, then detain them for life in wide islands, where, with the exception of bread and water, if they would not die, they must gain the rest of their fare by working. If, after this, they transgress repeatedly, sentence them to death. The educational reformatories, with all those precautions practiced at Elmira, I would reserve exclusively for young criminals guilty of crimes of occasion or of passion, and to these I would accord conditional liberty. The suspension of punishment, the study of the individual character, will help us to know them as much as the history of their case. Adults under judgment I would keep in prison cells whenever life in common does not facilitate the reciprocal tale-bearing which renders detection easy. But here, too, if the crime be one of occasion or passion, I would favor short-term punishments, fines, floggings, fasts, douches, etc. If, instead, the delinquency is instinctive, or recidivist, I would mostly inflict

perpetual punishment or even death, or, if the criminal be mad or a *mattoid*, put him into the criminal lunatic asylum. If his offense be political or religious, his punishment must last as long as public opinion is opposed to this form of crime."

Such, in a nutshell, are the theories which Prof. Lombroso has spent his life in expounding in writing and in speech, for whenever a specially complex case is brought before the law courts of Italy he is called in to give his scientific opinion, and his acute, shrewd, original, and penetrating judgments would, if collected, form a volume of most interesting and instructive reading, that should cause many a judge, and many a private person too, to hesitate ere pronouncing judgment. Not unfrequently he has found those to be innocent who to all appearances seemed guilty, and those to be guilty who seemed the flower of virtue. His theories are deduced from the most careful and minute observations of criminals and madmen, and it is only by studying these attentively and analyzing them that we can discover how and why Prof. Lombroso is convinced of the defects met with in all reformatories and penal houses, and by what process of selection he has arrived at his conclusions with regard to the evil and its remedies. Unfortunately, the professor, while a lucid and brilliant speaker, is a somewhat involved and arid writer, and it is no easy task to disentangle his ideas from among his voluminous and multifarious writings. Still, the study of criminal therapeutics is too interesting and too important to be neglected.

Now, Lombroso's cardinal point is, that rather than study crime when it is already mature, we should try to forestall it, if not by removing the cause, which might be impossible, at least by lessening its influence. Of course, we can not minimize such influences as the action of warm climates, the result of race, but we must adapt our laws so as to mitigate their effects by various methods, such as the more careful regulation of prostitution; the more speedy execution of justice, so that it may better impose on impressionable minds which are apt to forget the cause of the punishment if it follows the deed only after a long lapse of time; the care not to extend northward the laws which are proper to the south, and *vice versa*, and this latter especially in regard to all offenses committed against persons. Where conditions are still savage these can be much diminished by thinning the forests, the natural houses and fortresses of malefactors, by the opening up of roads, by the founding of cities and villages on sites of ill fame, as has been done in Italy to extirpate the brigands that infested certain districts; by dissolving all such societies as tend to be secret and are usually nurseries of crime (witness some of the Irish-American so-called patriotic associations), and by helping and encouraging the denunciation of evil-doers. Prof. Lombroso

also condemns very strongly and very properly the foolish habit that obtains on the European continent of extending full pardons to prisoners because a private event has taken place in a royal family, such as the birth of an heir, or the marriage of a prince. Punishment must be steady, equal, and not liable to such accidents on which the criminal, generally a fatalist, is apt to count. Further, it is always well, if it can be hindered, that a released prisoner should not return to his native place or habitual abode. A most special watch ought to be kept over the houses of receivers of stolen goods. These persons, who might be called the capitalists of crime, almost always go unpunished, and it is just they who should be smitten. The professor has great praise to bestow on the American vigilance committee, an institution he regards as wise in the extreme. He also lauds the English detection system and the Austrian *Vertraute*, who render splendid services by giving such persevering chase to criminals. He also proposes the alliance of all nations for the arrest of delinquents, as well as the sequestration of a person who boasts that he has committed a crime.

Alcoholism is a fruitful source of evil-doing. It is therefore desirable to prevent by all available means the diffusion of the liquor trade, either by exorbitant taxes or by a limitation in production. The statistics of Switzerland, Sweden, Holland, and certain parts of the United States and England show a very sensible diminution of crime since severe laws were enacted against the manufacture and sale of intoxicating drinks. Feasts, fairs, and markets should be diminished, when they are not called for by special and real commercial reasons. The mass should be educated not only by means of the alphabet, but should be taught elevated ideas with regard to work and personal dignity. Prizes should be instituted for the virtuous, and every aid should be given to extend the helpful labor of postal banks and co-operative stores. Yet another powerful incitement to crime is the public spectacle afforded by courts of justice. Entrance to these should be limited to well-known persons, and the mass be rigorously excluded. The modern tendency, fostered by the press, to make of a malefactor a hero, is greatly to be deprecated, and leads to crimes due to pure imitation, from a desire for notoriety, no matter at what cost. There should positively be forbidden those extended judicial reports in the newspapers, fruitful sources of eventual crime, which the people read with so much avidity. The State ought to promote and protect work in every way it can, for only by work can idleness be conquered, that too potent counselor of crime.

Lombroso holds that there are certain establishments where the notion of evil is first inculcated, and these, according to him,

are above all to be found in reformatories, to be commended in initial idea but to be condemned in the manner this idea is usually executed. Here, he holds, the young get to know vagabonds and idlers, whom they are drawn to copy by that instinct for imitation that exists in the youthful mind. The children associated in such places are often foundlings or the offspring of immoral families, or of parents incapable or unable to educate them. When these are brought together with children of good, honest families the latter are too frequently pushed into vice by bad example, by acquaintances made in undesirable places. It is undoubtedly our duty to care for the orphan and the foundling, but we must be careful above all to prevent their being dragged into guilt as well as to lift up those that may have fallen into it. It is from this very aim, as Lombroso knows, that has arisen the idea of reformatories and houses of custody for the young, which in France receive annually 7,685, in Italy 3,770, in Belgium 1,473, in Holland 161, and in America 2,400 individuals. But their utility, the professor holds, is not apparent. They have been founded in a frame of mind more benevolent than well informed as to the criminal nature. Too many and too complex are the causes, multiplied by mutual contact, of the evil they would cure, and this too at an age not tender enough to model, yet young enough to be expansive and inclined to imitation, especially of evil.

The over-agglomeration for economical reasons of individuals, and the admission into public reformatories of the worst subjects expelled from private establishments, annul every attempt at reform. Statistics show but too plainly the falling back into evil courses of the inmates of such institutions. The diminution in England of twenty-six per cent, which is attributed to the one hundred and seventy-two reformatories which she owns, Lombroso would assign instead rather to the diffusion of the twenty-three thousand so-called "ragged schools" that take care of millions of young people during the most dangerous age. In Italy, says Lombroso, it is too easy for fathers and guardians to place sons and wards in reformatories under pretext that they are wicked; and certainly it is not there that they will amend, since in such places there can not be carried into effect the nightly cellular system and the enforced silence which are an absolute necessity for rigid discipline, and to counteract the worst vices of the young criminal. From his own observations Prof. Lombroso is convinced that even in the so-called best-managed reformatories there prevail the worst sexual vices, not to mention theft, the *camorra*, such as is carried on in the penal hulks, the learning of the criminal jargon, the tricks of the trade, tattooing, and all other distinctive vices of criminal men. What remedy lies to hand? Prof. Lombroso writes, in his Uomo Delinquente,

"Charity, or rather foresight, must assume new forms, leave the ways of alms and the violence of prisons, and substitute spontaneous asylums and industrial schools."

Lombroso explains in detail what admirable work the New York "Society for the Reform of Youth" has done since 1853, by founding industrial schools and lodging houses; implanting the love for work in bad boys, giving them the knowledge of personal liberty, and the healthy desire to better their state by employing them in factories and workshops. He holds that Italy might advantageously copy and imitate such a reform, particularly in Piedmont, Sardinia, and the Valtellina, where sheep-tending utilizes the children.

When offenses in youths pass a certain limit so as to require heavier punishments, Lombroso contends that above all things the so frequent method of often-repeated and short-term imprisonments should be avoided with the greatest care. Instead, a graduated punishment should be substituted, like fasting, douches, forced labor, and isolation in their domicile; or, if it is preferred, fines might be imposed, thereby lightening the cost of maintenance. A money fine has also the great advantage of touching the modern culprit in his most vulnerable point.

If the crime be serious, then, according to Lombroso, prison cells are necessary in order to isolate the culprit from his companions. But our chief and primal aim should ever be education. We should strive to inoculate the delinquent with more than mere alphabetical instruction, we should teach him the practical knowledge of useful trades, and instead of futile preaching and moral teaching we should give him good or bad marks; passing him into privileged categories where he would have the right, for example, to wear a beard, receive visits, work for his own benefit, and so on. Thus, through those very passions which left alone would lead him on to greater wickedness, we must seek to inspire him with the need of honesty. Ferri tells of a thief who became an honest man when the Sister of Charity, with that very end in view, intrusted him with the care of the prison wardrobe.

Overstrictness is always harmful. It is far better to tickle the vanity of the prisoners—a feature highly pronounced in the criminal type—by permitting them to elect among themselves wardens and teachers, as well as arbitrators who shall decide concerning the misdeeds of their companions. This would help to awaken a spirit of comradeship, which is always beneficial. Lombroso inclines somewhat to Despine's method of not inflicting punishment until a little time has elapsed after the committal of the offense, to allow passion to cool down, if the offense be due to this cause.

With regard to employment for prisoners, all outdoor work is to be preferred; next come the works in straw, cord-making, broom-binding, typography, tailoring, terra-cotta molding, then last of all shoemaking and carpentering. To be absolutely avoided, because they open the way to new crimes, are such trades as blacksmiths, photographers, lithographers, and such like, wherever iron implements or chemicals must be utilized. Work must be proportioned to the strength of the prisoner: prison work should on no account be farmed out to contractors *et pour cause,* because these would naturally always protect the ablest men and not the most morally deserving. "Never impose work," says Lombroso; "let it be desired. The delinquent should ask for it, and having obtained it, it should never become for him a pretext for receiving greater privileges." The Elmira Reformatory, of which Lombroso speaks in the letter I have quoted, has, we know, served as a pattern to all penitentiaries in the United States, and has modified their methods. Mr. Brockway, its founder, who states that he imbibed all his ideas from Lombroso's Uomo Delinquente, started from this premise that the introduction of indefinite and unlimited punishment is necessary as the basis of a logical and efficacious moral system; that it is not enough to separate the congenital criminal and the occasional, the passionate, and instinctive, that to each one must be applied the cure that best suits him, as in a hospital each patient is treated in a particular manner. The physical treatment is directed toward the development of muscle, by means of douches, massage, gymnastics, and good diet. In the moral it aims at the strengthening of the will, teaching the prisoner self-control, and thus enabling him to hasten on his own liberation, which is granted as soon as he has proved himself to be worthy. Mr. Brockway divides the prisoners into three classes—good, moderate, and perverse; but from the last they can pass into the first through good behavior, love of work, and respect for the guardians. The work taught in Elmira is practical; the prisoner, as soon as he is liberated—and this, according to statistics, is very soon—will always find lucrative occupations. Self-respect once born within him, will go on increasing, unless he is a delinquent born, and here it is that Lombroso departs from Mr. Brockway; in that case he insists that every remedy will be vain. The criminal will eventually fall back, and only complete exile or death can save society from his disastrous operations. But in spite of this objection Lombroso holds that Mr. Brockway's system, subject to a few modifications, which would take us too long to examine in detail, is useful as far as it goes in the present incomplete and chaotic state of equity in which scientific laws and legal justice do not correspond in their actions. He holds that it is particularly to be commended for

juvenile delinquents, whom a gentle, loving care will rehabilitate better than a severe prison *régime* conducted on the old lines. Lombroso is greatly in favor of the Irish graduated cellular system, by which the culprit regains little by little an almost complete liberty. In this wise there results to the state a sensible economy—a fact not to be despised, seeing the large cost to society of these useless members of the body politic. He also lauds the Danish system, another graduated method founded on repaid labor, and provisional and conditional liberty. Nor does he forget Saxony, where the system which he calls "of individualization" has given such excellent results.

He strongly urges that on quitting prison the interest only of the capital he has acquired by his labor should be accorded to the prisoner. This will help to keep him straight, and retain him under a moral control. The professor is absolutely opposed to deportation to colonies. For the incorrigible delinquent, Lombroso counsels, as the only way of supplanting capital punishment, to which in extreme cases he is not opposed, a perpetual exile from society, into which the criminal will not be able to return unless he gives irrefutable proofs of amendment.

"No matter that their criminality springs from infirmity," he writes, "they are equally dangerous to themselves, to us, and to their offspring; and their rigid isolation is more useful and less unjust than that of lunatics."

And this brings him by a natural transition to the very important question of criminal lunatic asylums, institutions counseled by humanity as well as by social security. Among delinquents, and those believed to be so, there are many who are and always were demented, and whom to imprison would be to treat unjustly. In Italy such persons are as yet provided for only by half measures which violate both morality and security. In England they have attempted for a century, and for sixty years have almost succeeded, in settling this question by instituting criminal madhouses. In 1786 this species of lunatics were confined in a certain part of Bedlam; in 1844 the state undertook to maintain two hundred and thirty-five in a private establishment in Fisherton House, but as the sad bands of those unhapy ones grew it ended by erecting special madhouses. In 1850 one was opened in Dundrum for Ireland, followed by one in Perth for Scotland, and in Broadmoor for England. In these houses, regulated by suitable decrees, admission is given not only to those that have committed crime in an access of madness or who have become mad during their trial, but there are also shut up those that on account of lunacy or idiocy are incapable of undergoing prison discipline. In America this reform has already brought about the criminal asylums of Auburn, in Pennsylvania,

and in Massachusetts. In Italy most of these unhappy creatures are held to be lazy, riotous, perverse, or deceitful, and when their lunacy is admitted it is difficult to obtain their admission into asylums, and this because this special class of lunatics are dangerous inmates for ordinary madhouses. They steadfastly resist all discipline, they permit themselves obscene and violent acts: they are discontented with everybody and they evince themselves indifferent to punishment; in a word, they carry into the madhouse the habits and vices of the immoral class from which they spring, and thus become apostles of sodomy, rebellion, robbery, and desertion, to the detriment of the establishment and of the other lunatics. Often, too often Prof. Lombroso says, such men are allowed to wander free in the midst of society, and are the more dangerous because under an apparent calmness and lucid intelligence they retain their diseased impulses, giving proof of this when least expected. The professor cites several examples, and holds that to men thus mentally afflicted are due the epidemical madnesses that show themselves in the form of Nihilism, Mormonism, Anabaptists, the incendiaries in Normandy of 1830, and the Parisian Commune.

He insists rigidly on the point that this institution of criminal lunatic asylums is not due to sentimental pity, but is a pure measure rather of social precaution than of humanity. And against the objection that might be raised that real madmen may be confounded with dissimulators, Lombroso sets the development of modern anthropologic studies, which rarely, when the diagnosis is carefully made, falls into error on this point. By the institution of criminal lunatic asylums we obviate the transmission of the disease to offspring, we hinder recidivism and its consequences, which at best lead to the heavy cost of a new trial for the criminal. And that the theory is proved by practice to be correct is evinced by the fact that gradually the objections of adversaries are being overcome, so that criminal madhouses, under different forms, are being established in Denmark, Sweden, and France, where, since 1876, there exists one at Gaillon annexed to the central prison. The other civilized peoples of Europe, if they have not real criminal madhouses, have certain laws and institutions that in part answer the same purpose, as in Belgium, at Berlin, Hamburg, Halle, and Bruchsal. In Italy not only are there no such special establishments, but there is not even a line in the codex admitting the possible necessity for any such institution. Prof. Lombroso invokes these salutary provisions in ardent terms. He writes: "The orbit of crime is too deeply engraved in the book of our destiny for us to delude ourselves that we can suppress its course. But if other undisputed laws do not fail us, like those concerning the selection of species, we may hope by such prevent-

ives to moderate the effects of crime and to hinder its widespread diffusion."

Deterrents, preventions—these two words may be said to be the keynote to Lombroso's system. If he have a favorite proverb, it is certainly that "prevention is better than cure." On this account he would segregate from society the adult criminal, in order to deter him from exercising his pernicious instincts, and he would direct his chief and best energies to the rising generation.

Can we make it possible for a child that has criminal tendencies not to become a criminal? This is his chief problem, and this question he answers with a decided affirmative.

So long as the criminal acts are not repeated to excess, and when they are not accompanied by all the anthropometrical characteristics of criminality, there is hope to be found even in this dismal science. The evolution of good takes place in a sound man in spite of a bad education. Anticriminal education must, therefore, begin as soon as the first pernicious symptoms show themselves; on the other hand, excessive severity must be avoided, and more must not be asked of the child than it can do. The more gentle the corrections, the more efficacious will they prove. For example, if the child has spoiled a favorite object, buy it again at your own expense, but deprive him of some sweetmeat, some amusement. If he dirties the house with his games, let him repair this evil; never mind if it draws down on him some scalds and scratches; only let him have been advised beforehand to avoid the deed, and told what consequences would follow disobedience. When he does not obey orders, show him less sympathy, but never fall into a rage, for anger is as harmful to the parent or guardian as to the child. A useful reaction only follows when the punishment is given in a calm spirit. Above all, endeavor to get the child to correct itself rather than to depend on the violence of a monitor. One should prevent rather than encourage in children, as is done by the majority, the constant association of the idea of punishment with a bad action. In consequence, when the time has come to liberate him from the leading strings of master or parents, he is no longer afraid of committing offenses, thinking they will now cease to carry judgment in their train. This constantly happens to children of overstrict parents, who when grown up and independent are apt to commit great misdeeds and even crimes.

These reasons are doubly applicable to young criminals, who can not be properly watched and educated in reformatories on account of the large number of their inmates. The divisions and subdivisions admitted of in such places are not sufficient to cover all the varieties of bad tendencies a child with criminal instincts

will develop. This is one of the most salient points of the problem. Lombroso cites an experiment made by a naturalist who placed together in an aquarium, divided only by a piece of glass, some carps and some of the little fishes they eat. At first the carps knocked violently against the glass to catch their prey, but after a while, seeing that their attempts were vain, they abandoned them, and when after a while the glass was removed they lived together in harmony. By habit they became innocuous if not innocent. So also the dog by custom and education ceases to steal. It is by such methods that Lombroso holds that congenital criminals must be cured, and not by baths and gymnastics or "collegiate prisons," which are powerless to affect moral habits.

These new theories and systems have ardent followers, but obviously also encounter violent opposition.

To Italy, to her honor be it said, belongs the due that she was the first in Europe to instigate and propagate the study of criminal anthropology. It may indeed be claimed for her that in that fair land the positive method is of ancient origin and that it sprang up in the Renaissance with Galileo. It attracted less attention as long as it was limited to the physical and natural sciences; but when it was carried into the moral and social field it awakened diffidence, and of this diffidence the effects were felt by men like Claude Bernard and Comte, in France; by Spencer, in England; by Lombroso and Garofalo, in Italy; and by Wundt, in Germany. But all the men, nevertheless, pursued their course undaunted. Indeed, most of them hold, and Lombroso above all others, that all this opposition on the part of their adversaries is desirable, as it spurs on to new exertions and helps to emphasize the deductions of the positive school, based as they are on minute anthropological researches.

Lombroso's firmness of purpose in the pursuit of his studies may best be estimated by quoting his own words with regard to his life's work:

" . . . me rallier sans convictions au jugements du public moyen, en venir au moindre compromis pour l'amour de la paix, m'arrêter un seul instant dans le travail incessant de renouvellement juridique et psychiatrique, auquel je me suis voué; ce serait non seulement m'avouer vaincu, mais ensevelir avec moi tout le travail de ma vie. Jusque-la n'irait pas même l'abnégation . . . la plus chrétienne."

Surely he is a worthy successor and compatriot of Galileo. Even that great blind scientist spoke no prouder words when, tortured by rack and priests, he muttered, "*Eppur si muove*."

# ANTHROPOLOGY AT THE WORLD'S FAIR.

By Prof. FREDERICK STARR.

EVERY great international exposition is, in a certain sense, a practical study in anthropology. Recent world's fairs have, however, shown more and more a tendency to make an especial exhibit in anthropology and kindred sciences. This was very noticeable in 1889 at Paris, and in our own World's Columbian Exposition there is an especial department—Department M—of Anthropology, under the directorship of Prof. Frederick W. Putnam. A building has been erected for its purposes, and the larger part of it is occupied in illustrating "man and his works." Naturally, to this building the student in anthropology will first turn in looking up the matter of anthropology at the fair.

In this building he will find collections in ethnography, in archæology, and in physical anthropology. As one passes through the main entrance he sees reproductions of Assyrian sculptures; to the right are collections in North American ethnography; to the left series illustrating North American prehistoric archæology. Among the notable private collections illustrating the ethnography of our American Indians are those of D. B. Dyer and Edward E. Ayer. Mr. Dyer's collection is mainly representative of plains tribes, and is rich in cradles or papoose-boards and in implements for gambling. Mr. Ayer's collection is from a larger range of peoples and represents quite fully the dress, implements, and arts not only of the plains tribes, but also of the peoples of the Northwest coast and of the Southwest. His collection of modern Pueblo pottery, the straw dresses of the California Indians, the carved work from the Northwest coast, are of special interest. Near these collections is the large series from the Northwest coast gathered by Dr. Franz Boas and his helpers, particularly rich in dancing paraphernalia, masks, bark necklets, and the like. On a raised platform, extending for many feet, near this, Dr. Boas has set up a reconstruction of the village of Skidgate, one of the most important villages of the Haidah Indians. The models of houses and totem posts which make up this reconstruction are of native workmanship.

Among the archæological collections are some of unusual interest. Prof. George Frederick Wright, of Oberlin, illustrates the material and structure of the terminal moraine of the United States by specimens of bowlders, striated surfaces, photographs, and diagrams. The exhibit is made with reference to the question of palæolithic man in America, and in the collection are pictures representing localities where claimed "palæoliths" have been found. The largest collection of implements from glacial gravels in this

country is that of the Peabody Museum at Cambridge, and a series is here shown from that institution illustrating the finds from the now famous localities in New Jersey, Ohio, Delaware, etc. Of considerable importance is the small, carefully selected, and neatly displayed collection from the Canadian Institute of Toronto, which is rich in rare forms of bird amulets, gorgets of striped slate, pipes of stone, and bone implements. The State Historical Society of Missouri exhibits a handsome series of the white chert implements so characteristic of that district, as also hematite objects and fine mound potteries. In cases near by is a magnificent series of Wisconsin copper implements—spear-points, knives, arrowheads, etc.—partly displayed by the State Historical Society and partly private property. Colorado sends a considerable display of cliff-dwelling relics. Of prime importance is Mr. Warren K. Moorhead's gathering from the mounds of Ohio. Mr. Moorhead was sent by the Exposition management to the district rendered classical for American archæology by the work of Squier and Davis. He was successful beyond all expectation, and here are gathered the results of his excavations—hundreds of spool-shaped ear ornaments of copper, mica ornaments, wonderful blades of obsidian from altar mounds, stone pipes, thousands of chert disks from one mound, a find of copper ornaments surpassing any ever found before in American mounds, an antler-form headdress unique in shape and character. Besides these, Mr. Moorhead has made a reconstruction of one of the very interesting stone graves of Fort Ancient, with the skeleton in its proper position. In connection with this important series it should be mentioned that Prof. Putnam has near it several models of important mounds, the most interesting representing the famous serpent mound of Adams County, the preservation of which is due to an interest aroused by Prof. Putnam in the ladies of Boston. The model aims to reproduce not only the mound itself, but also the topography and conditions of the surrounding country.

Of foreign countries, several are represented in this building by collections, ethnographic or archæological. The explorations of Charnay, of the Peabody Museum, and others in Yucatan, Honduras, etc., are illustrated by a magnificent series of direct reproductions in plaster. The wonderful wall carvings of Lorillard City, the zapote wood carvings of Tikal, the strange monoliths of Copan, are all here to be seen, true to life; elegant photographs and fine enlargements, the result of Mr. Saville's recent work in those districts, represent Uxmal, Labnah, and Chichen-Itza accurately. With this wonderful series from Yucatan and its neighborhood is Mrs. Nuttall's interesting exhibit of Aztec shields. It will be remembered that this lady recently discovered in the old castle of Ambras an ancient Mexican feather-covered

shield. These objects are exceedingly rare, and the discovery led Mrs. Nuttall to make a careful study of the whole subject of Mexican feather shields. The exhibit consists of a copy of the shield at Ambras, and the reproduction of a considerable number of others from pictures in the old pictographic books of the Aztecs. Near this section is an exhibition of the archæology of Peru. Mr. Dorsey was sent out by the Exposition management to make

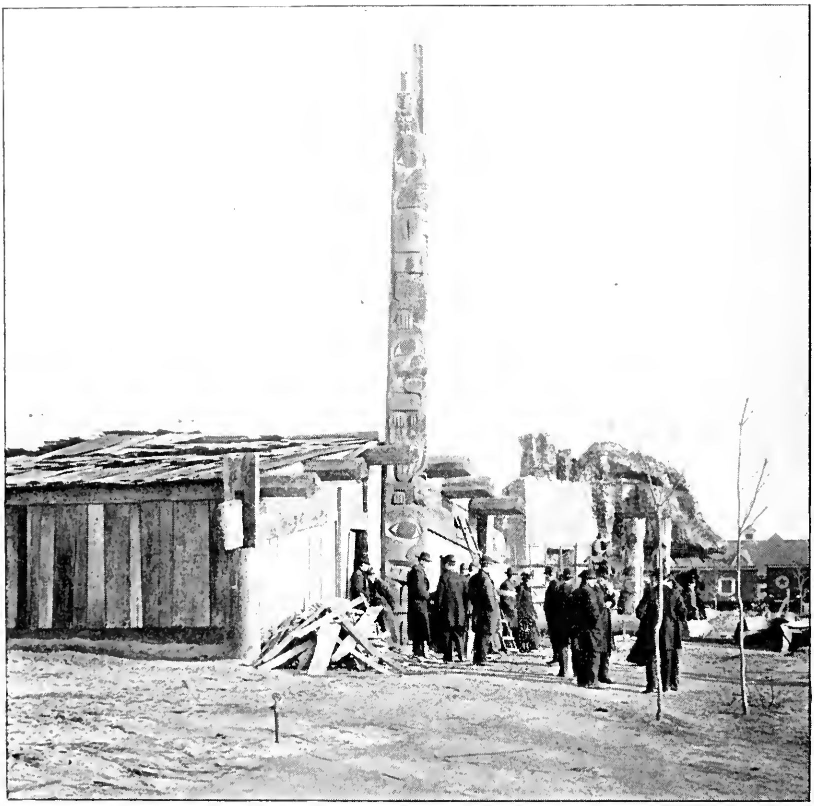
Restoration of Maya Ruins (Yale). World's Columbian Exposition.

collections in the land of the Incas. A considerable number of graves were opened and much material was secured. Several table cases contain the results, and in two inclosed spaces Mr. Dorsey aims to show the old Peruvian method of burial. Mummies in their original wrapping are set in their proper position, together with all the funereal furniture—the face-mask, the square cloth-covered tablet, the articles of daily use, the pottery and ornaments. Mr. Dorsey exhibits in one table case a very interesting little collection of broken pottery and engraved stones from a new locality, La Plata Island, in Ecuador, which bids fair to be a spot of importance to future investigators. Besides these interesting series secured by the efforts of the management of the Exposition, there are exhibits by Costa Rica, Mexico, Paraguay, and New South Wales. Costa Rica's display deserves more than a passing word. A neat pavilion, with walls adorned with oil paintings illustrating natives of the country and points of archæological

interest, contains several cases in which a series of specimens selected from the National Museum illustrates the ancient pottery, stone implements, and carvings of the country. Mexico gives a display neither full nor satisfactory, in part ethnographic, in part archæologic. Here are trophies composed of reproductions of ancient shields, spears, and battle clubs; here are models of old buildings of the Mexico of Cortés; here are a few original specimens in archæology and many plates from a work on Mexican antiquities. So much might have been done: so little really is done! Paraguay sends a considerable ethnographic display, particularly rich in feather work, in nettings, and in spears. New South Wales sends carved work from the south seas, especially the characteristic black, shell-inlaid work from the Solomon Islands, boomerangs from Australia, spears, bark cloth, etc., from various localities. Most important of all, however, are the magnificent great photographs representing natives, wild life, and arts of the south sea islands and Australia. Mr. Culin, on his own behalf and for the American Folk-lore Society and the University of Pennsylvania, displays a collection of games and some objects connected with worship. The series of games is particularly interesting, and represents the indoor pastimes of all peoples and all times.

In the north gallery of the Anthropological Building is a most important laboratory and exhibit in physical anthropology. The laboratory itself falls into three subdivisions: Physical anthropology (somatology), neurology, and psychology. Dr. Franz Boas has general charge of the whole, while Prof. Donaldson (Chicago) has charge of the subdivision of neurology and Prof. Jastrow (Wisconsin) directs the work in psychology. There are a number of rooms devoted to these laboratories. First there is presented a series of instruments used in anthropological investigation—anthropometric machines, craniometric instruments, instruments for drawing skulls, outlines of the body, etc. The types of mankind as found in Europe, the south sea islands, America, etc., are shown by portraits, masks, diagrams, maps, and other material. Composite photography, as applied to finding types and in the study of crania, is illustrated. Francis Galton's method of taking finger prints is illustrated and a considerable series of impressions taken from the finger tips of Indians of North America by Frederick Starr and Mr. David Barrows is displayed. Here also are the results of Dr. Boas's recent investigation into the physical structure of the North American Indian. A number of observers were sent to take measurements among our native tribes. Many thousand sets of measures were taken. Each set comprised a dozen measurements and descriptive matter covering about thirty points. This mass of material has been

studied carefully, tabulated, and reduced, at least in part, to graphic form. Diagrams show the distinctive characters of tribes and the effect of environment, the influence of crossing, and the like. Maps instructively show the variation of stature and other characters with changes in physical geography. In neurology Prof. Donaldson, by a series of models and casts, represents the brain form in man and lower animals, the structure of the brain, localization of function, and modes of brain preservation for



House of Kwakiools (Vancouver Island). World's Columbian Exposition.

study. Prof. Jastrow's two rooms are of great interest: in one, arrangements are made for conducting the various tests of so much importance in modern psychological study; in the other, in a series of cases, is a full representation of the instruments and apparatus used in experimental psychology—instruments for investigating the senses of touch, light (color), hearing, etc., as well as for recording, timing, and the like. All these laboratories are expected to be in operation, and observations and experiments will be conducted by a corps of student assistants.

Near the Anthropological Building are several outdoor displays of more than usual interest. The party sent out by Prof. Putnam to the ruins of Yucatan and Copan secured at Uxmal, Chichen-Itza, and Labnah "squeezes" of some doorways, corners, arches, etc., showing every detail of ornament and symbolical carving. From these molds casts have been made exactly reproducing the structures. A group of five of these lies north from the Anthropological Building. North from this is an interesting series of homes of various American Indians. The palm-thatched hut of the Arawaks of Guiana; the long house of the Iroquois, constructed of bark, and divided into six spaces within, one for each of the Six Nations; the birch-bark tent of the Penobscot Indians of Maine; the skin-covered tepee of the plains tribes; the dome-shaped framework of poles, covered with rush matting, of the Algonkins; the plank-covered houses of the Kwakiool of Vancouver Island, and the Haidah of Queen Charlotte Islands with their symbolical paintings and totem posts: these range along the edge of the lagoon on whose waters float various canoes and boats of the natives. These houses have been built from proper materials by the Indians themselves, and most of them are inhabited by families of Indians, some of whom carry on their native arts and industries. Very interesting in this connection will be the series of dances of the Kwakiools, for which Dr. Boas has arranged, which will take place at intervals through the season.

Most interesting material is found in the United States Government Building. The National Museum, through Prof. Mason, has set up a suggestive series illustrating the groups of Indian tribes. A great copy of Powell's Linguistic Map of North America upon the walls represents the groups of tribes as classified by language. In alcoves below, cases full of objects illustrate the arts and industries of these groups. It is most interesting to notice how clearly the influence of environment and the gifts of Nature is shown in the arts and industries. Tribes speaking languages of one stock may show marked diversity in arts if living in unlike surroundings, while tribes widely differing in language may show industrial unity if subjected to similar environments. Very interesting to the crowd are the cases wherein are displayed life-size figures dressed in costumes. Some of these are particularly pleasing: the Xivaro, with his feather belt and crown; the Chippewa blanket painter; two plains Indian women dressing a buffalo hide—one kneeling before a hide hung upon poles scrapes it, while the other pounds a second hide with a stone maul: a Moki man drilling a turquoise bead with a pump-drill; a Sioux squaw and children on a pony dragging the *travois;* a Mojave man with apron of bark strips, head feathers, and a shell orna-

ment; a Hupa woman and girl in straw caps and dresses, with a papoose in its pretty basket cradle—these and other carefully chosen and usually well-executed groups give life, reality, and meaning to the objects in the cases around.

In a large alcove near by, occupied in great part by models of cliff-ruins, pueblos, and other monuments of the Southwest, are two interesting exhibits from Mr. Thomas Wilson, of the Smithsonian Institution, and Mr. William H. Holmes, of the Bureau of Ethnology. Mr. Wilson aims to present a synopsis of prehistoric archaeology. The relics of palæolithic man from France, England, Egypt, and India are fairly represented. Next to them are placed some of the claimed palæoliths of New Jersey and Minnesota. Rude implements of forms akin to palæoliths but of uncertain or negative geological relations from all parts of the United States follow. A good neolithic series from the Swiss lake dwellings and the tumuli of Denmark is shown. Fine specimens illustrate work in polished stone in America. The bronze age in Europe, illustrated by objects from Switzerland, France, etc., is set alongside of objects of copper from American mounds and bronzes from Mexico. Some of the finer objects in jade, quartz, crystal, and obsidian from Mexico, and stone collars and mammiform stones from Porto Rico, complete the exhibit. Mr. Holmes's series is intended to illustrate Indian quarrying and mining. It is altogether a model display. The now famous quarry at Piney Branch, near Washington, is first illustrated. On this site the Indians formerly quarried pebbles, from the gravel deposits, for making into implements. These pebbles were worked up into "blanks"—oval or leaf-shaped—from which, later and elsewhere, spear-points, arrowheads, and the like were made. In making these blanks many pebbles would be found to be worthless and would be rejected. These rejects and the blanks themselves closely resemble our American "palæoliths," and Mr. Holmes believes that some at least of our American palæolith localities are old quarry sites, and that the palæoliths themselves are rejects. There can be little doubt that the showing of this idea has much to do with the making of this display. The exhibit, however, is so complete and excellently worked out that it has profound value apart from any theoretical interest. In regard to Piney Branch Mr. Holmes displays in table cases a series of pebbles, rejects of every stage, and blanks; along the wall above are specimens showing every stage from the pebble, through the blank, to the arrowhead or spear-point. Above this series are framed diagrams, sections of the quarry, and maps, also a fine series of photographs. Clear, explanatory labels accompany all. In exactly the same way Mr. Holmes illustrates an interesting quarry of chert in Peoria Reservation, Indian Territory; the novaculite quarry of Arkansas; the

Group of Kwakiool Indians (Vancouver Island). World's Columbian Exposition.

chert diggings of Flint Ridge, Ohio; the rhyolite quarry of Pennsylvania; and the quarry of flint nodules in Texas. These all differ from Piney Branch in that the material is quarried from solid rock ledges, not from soft gravels. The quarrying of soapstone in the District of Columbia and the making of it into bowls, the mining of copper in the Lake Superior district, and the taking out of the famous red pipestone from the quarry in Minnesota are all illustrated in the same complete fashion. As a representation of an important and interesting aboriginal industry nothing could be better.

The anthropologist finds two collections of interest in the Woman's Building. In a dozen cases Prof. Mason shows "woman's work in savagery." The development of personal decoration, the preparation and serving of food, the making of basketry and matting, embroidery and needlework, beating of bark cloths, weaving by hand frames and looms, dressing of leather, and pottery-making are the chief points represented. The fact that woman has been the chief actor in originating and developing every peaceful art is impressively shown. By the side of this series is Mrs. French-Sheldon's collection. Every one knows of this woman's exploration of East Africa. With no white companions, with an escort of hired porters and guides under no command but her own, she penetrated a thousand miles into Africa, among tribes some of which, like the Masai, were on a war footing. She has brought out from the dark continent thousands of objects illustrative of the daily life, the arts, and culture of the natives, and here one may see them displayed as a monument of a remarkable undertaking. Fine shields, carefully leaf-shaped spear-heads of iron, objects of personal adornment, native dress, wood carving—these are but a few of the many objects. Mrs. French-Sheldon herself is frequently in attendance, and proves as much of an attraction as the collection.

The student of culture-history must find objects of interest everywhere, frequently where one would scarcely expect them. Thus the Baltimore and Ohio Railroad makes a wonderful exhibit, under the title of The World's Railway. A magnificent series of pictures, models, and original specimens illustrate the whole history of the development of the locomotive, the cars, and the tracking. In the Shoe and Leather Building colored pictures and many wall cases full of specimens show the footwear of all ages and all peoples.

At Paris one of the most attractive features was the representation of outlandish peoples. At Chicago the Midway Plaisance supplies the opportunity to see many strange sights. The German village and Old Vienna are true architectural reproductions. The Chinese theater and its temple annex, with the native

music and the long plays, give an opportunity, rare east of California, to see the dramatic art and religious rites of the Celestials. The Dahomey village, with mud-daubed huts, on which are scraped queer animal and bird figures, and its war-dance on a central platform, gives a real glimpse of negro Africa. The street of Cairo, narrow, crooked, with its bazaars, shops, and booths along both sides, its donkeys and camels, its school with children crying the Koran aloud, and its juggler plying his mystic trade, attracts great crowds. The Egyptian temple with its dancing dervishes, a Lapland village, Javanese village, Polynesian settlement, Algerian and Turkish theaters are among the other attractions on the Midway Plaisance where one may study ethnogra-

Eskimos from Labrador. World's Columbian Exposition.

phy practically. Two concessions of unusual interest are not on the Plaisance, but in the main Exposition grounds. These are the Eskimo village and the cliff dwellings. The Eskimo village has been located for a long time; and last winter, when snow filled the air and the pond was ice-covered, its inhabitants were a happy crowd. They amused themselves and their visitors by sledding with dogs, skating on old wooden runners, and whipping pennies with their long-lashed dog-whips. Several babies were born in the village, and some died. One little fellow, Christopher Columbus, was an especial pet with visitors, and managed to live despite the many attentions he received. Dressed in their furs these people looked truly polar, but we are assured that as spring came on

they rebelled against wearing these heavy garments, which were unlike anything they ever wore before. It seems they came from a part of Labrador often visited by vessels, and are used to clothing made of white men's cloth. The cliff dwellings are located near the Maya ruins, and are the work of Mr. H. Jay Smith. They appear externally like an irregular mass of reddish-brown rock, with mule tracks winding up its sides. Entering it, we find ourselves in a great cavern, lighted from above, in which are excellent reproductions of the cliff dwellings of the Southwest. Several of the more famous ruins are here presented, made to scale sufficiently large to be truly impressive. Further in are single rooms, or small clusters of them, with fireplaces, T-windows, and other details reproduced in full size. A great hall cased along the walls is devoted to an excellent collection of objects from the ruins — stone implements, fire-sticks, fabrics, feather clothing, sandals of yucca fiber, dried bodies (mummies), some still in their original wrappings, pottery in many fine and rare pieces, food materials, etc. The idea is a good one and the execution creditable.

Comparatively few governments can be said to present in their exhibit a complete picture of their life and thought. One land, however, makes an exhibit most full and interesting—Japan. Early in the history of the Exposition the Land of Sunrise showed its interest. It is represented in nearly every department. Its fine-arts display includes choicest treasures; in the liberal arts are marvels of work in lacquer, bronze, porcelain, and silk; in the Horticultural Building is one of the marvelous gardens of Japan, with its elements grouped to form a miniature landscape—a fish-pond, rustic bridge, pretty wreaths of fern roots clothed with green, stone lanterns, and wonderful dwarfed aged evergreen trees; the agricultural display, showing not only the products themselves, but the tasteful packing and preparation of them for use—tea boxes (beautiful whether plain or elaborately decorated), tea in jars with silk covers and finely tasseled cord; *sake*, or rice wine, in elaborately lacquered jars; fibers, cloths, vegetable wax, barley honey, candies, mattings, silks; in the Forestry Building are the various woods used for all purposes, and a set of curious native pictures representing scenes in the lumber camps. Besides all these beautifully complete and daintily arranged displays, the Japanese have erected on the wooded island a group of three buildings called collectively the Hooden. They are copies of three famous buildings—a monastery of the Zen Sect, at Kioto, erected in 1397; a structure dating from 1052, representing the phœnix; and the main building, a palace of about the time of Columbus. These are of Japanese material, built by Japanese carpenters, and are of exquisite workmanship. They have been presented by the

Government of Japan to the city of Chicago, and are to be kept filled with interesting collections, which will be changed from time to time. To visit these various exhibits of Japan is to gain an insight into most delightful features of Japanese art, life, and character.

Although results of great importance to anthropology in America must result from all this display of material, it is believed that other permanent results must come from the congress and the library. In August an International Congress of Anthropology is planned. To it are invited the world's workers in the science, and before it are to be read important papers. The American Association for the Advancement of Science, the American Folk-lore Society, and the American Psychical Society unite in seeking the interests of this congress, and from it should come decided impulse to our anthropological work. As to the library, Prof. Putnam has issued an appeal to anthropologists asking contributions of all they have written in the science as a donation to a permanent library of that subject, to be located in Chicago, in connection with the Memorial Museum. The collection is to be catalogued and the catalogue published. Should this plan be carried out, the catalogue would be the best reference list to anthropological literature ever prepared.

It must be plain that in the Chicago Exposition we have a great object lesson in anthropology: a museum of somatology, archæology, and ethnology; a picture of ethnography; a laboratory of unusual completeness; a great meeting of workers; and the publication of new material.

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A NOTE presented in the French Academy of Sciences from Dom D. Démondin relates to the manifestation of sudden variations of temperature at fixed times in the latter half of January, as observed during more than six hundred years past. The author has examined with regard to this subject meteorological notes recorded between 1582 and 1879, or during about three hundred years; and for the preceding three centuries he has consulted various public documents, particularly the Annales des Dominicains de Colmar, from 1211 to 1305. He has thus verified, as for the centuries included, alternations of temperature marked by a depression about the 18th and an elevation toward the 23d and 29th of January, the temperature continuing low during the intervening days.

IT has been suggested by Colonel H. W. Feilden that the musk ox might with great advantage be introduced into Great Britain; and the author sees no reason why it should not thrive on the mountains of the Highlands in Scotland. It is covered in the winter season, besides its coat of hair, with a long-stapled fine wool, of a light yellow color, and as fine as silk. Sir John Richardson says that stockings made from this wool are handsomer than those from silk. Young musk oxen are easily reared and tamed, and could probably be procured from the arctic regions without great difficulty.

## RECENT SCIENCE.

By PRINCE KROPOTKIN.

II.

At one of the recent sittings of the French Academy of Sciences, Henri Moissan, whose name has lately been prominent in chemistry in connection with several important discoveries, read a communication to the effect that he had finally succeeded in obtaining in his laboratory minute crystals of diamonds.* His communication was followed by a paper by Friedel, who has been working for some time past in the same direction, and has attained similar though not yet quite definite results; and, finally, Berthelot, who also was working in the same field, but followed a different track, announced that, in view of the excellent results obtained by Moissan, he abandons his own researches and congratulates his colleague upon his remarkable discovery.

The discovery is not absolutely new, and the French chemist himself mentions two of his English predecessors. Mr. Hannay obtained in 1880 some diamondlike crystals by heating in an iron tube, under high pressure, a mixture of paraffin oil with lampblack, bone oil, and some lithium; † and in the same year Mr. Sidney Marsden, by heating some silver with sugar charcoal, obtained black carbon crystals with curved edges. ‡ Besides, it was generally known that a black powder, composed of transparent microscopical crystals having the hardness of diamond, is deposited on the negative electrode when a weak galvanic current is passed through liquid chloride of carbon. But these crystals, like those of Mr. Marsden, belong to the easily obtained variety of black diamonds known as carbonados; while some of the crystals obtained by Moissan are real colorless and crystallized diamonds—the gem we all know and admire.

For industry and every-day life the infinitesimal quantities of diamond dust obtained by the French chemist may have no immediate value, and some time will probably be required before a modest-sized jewel is made in a laboratory. But the discovery has a great scientific interest, inasmuch as it is the outcome of a whole series of researches which have recently been made with the view of artificially reproducing all sorts of minerals and rocks, and which are admirably chosen for ultimately throwing new light upon the intimate structure of physical bodies.

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* Comptes Rendus de l'Académie des Sciences, February 6, 1893, tome cxvi, p. 218.

† Proceedings of the Royal Society, xxx, 188; quoted by Moissan.

‡ Proceedings of the Royal Society of Edinburgh, 1880, ii, 20 (Moissan's quotation).

Moissan's method is based upon the capacity of iron of absorbing carbon at a high temperature and of giving it back in the shape of grains and crystals while the iron mass is cooling. When iron has been saturated with carbon at a temperature of about 2,000° Fahr., a mixture of amorphous carbon and graphite is discovered in the iron mass. At higher temperatures the fused iron dissolves more and more carbon, and the cast iron of our blasting furnaces, after having been heated to about 3,000° and slowly cooled down, contains, as known, an abundance of graphite crystals. It was thus natural to see whether a still higher temperature, and cooling under high pressure, might not give the still denser form of carbon—that is, the diamonds.

In order to thoroughly saturate iron with carbon at a high temperature, and to cool it under a high pressure, Moissan resorted to a very simple and effective means. He took a hollow cylinder of soft iron, filled it with some purified sugar charcoal, and corked the cylinder with an iron screw. Then about half a pound of soft iron was molten in a crucible in Moissan's new electric furnace, which readily gives a temperature of about 3,000° C. (5,400° Fahr.), and the cylinder was plunged into the molten metal; iron was thus thoroughly saturated with carbon. The crucible was then taken out of the furnace and plunged into a pail of cold water until the surface of the iron mass was cooled to a dull red temperature, whereupon it was taken out and left to cool in the air. This was the ingenious means of obtaining a high pressure. It is known that water when it becomes ice increases in volume, and that if it freezes in a strong shell the interior pressure of the crystallizing water often bursts the shell; but if it can not burst the shell it necessarily solidifies under an immense pressure, due to the molecular forces. The same was done by Moissan with the liquid iron, which also has the property of increasing in volume while it solidifies. An outer solid crust having been formed by a sudden immersion into cold water, the crust prevents the further expansion of the iron mass, which is thus bound to solidify under an immense pressure, like the water in the shell.

The next step was to separate the iron from the carbon crystals which it might contain. This was done by dissolving the iron in hydrochloric acid, and three different varieties of carbon crystals (which are not attacked by the acid) were received as a residue. Some graphite, some chestnut-colored, curved needles of carbon, and diamond dust could be seen; and they were separated from each other by several complex operations indicated by Berthelot in one of his previous works. A few grains of diamond dust were finally obtained—most of them belonging to the carbonado variety, while a few of them proved to be real diamonds; they were

translucent, they scratched a ruby, and they distinctly showed under the microscope the crystalline structure and cleavage of the diamond: their density was that of the precious gem, and they were completely consumed in oxygen at a temperature of 1,890°.*

Mr. Marsden's experiment with silver was also repeated; but silver being a bad dissolvent for carbon, even at a high temperature, it was boiled for some time with sugar charcoal in the furnace, the cooling being operated in the same way as with iron. The result was extremely interesting. No diamonds were obtained, but a series of carbonados of different densities (from 2·5 to 3·5 times heavier than water) were discovered, some of them in grains, some others in needles, or in conchoidal masses, the densest ones also scratching ruby and burning in oxygen at 1,800°. This is perhaps the most interesting part of Moissan's researches, as it confirms the long-since suspected fact that there is a whole series of carbon molecules each of which is composed of a different number of atoms, and some of which must be very complex.

As to the quantities of diamond dust obtained in this way, they were extremely small. Several cylinders gave no diamonds at all, and from all his experiments Moissan could not collect even a few milligrammes (a few hundredth parts of a grain) of the precious dust, although the black carbonados were quite common. But a sure method is now indicated, and its further development is only a matter of time and perseverance.

The scientific value of these researches is undoubtedly very great. Diamond, like graphite and simple charcoal, is pure carbon, but all attempts at fusing carbon or dissolving it have hitherto failed; it could not be brought into a liquid condition out of which it afterward might crystallize. However, the investigations recently made into the carburization of iron, especially by Roberts Austen, tended to prove that in steel and cast iron the carbon is not simply diffused through the iron, but enters with it into some of those combinations in definite proportions which, like all solutions, occupy an intermediate position between real chemical compounds and purely physical mixtures.† It was reasonable, therefore, to presume that carbon is brought into a liquid condition in molten iron, and that under certain conditions it may crystallize in the shape of diamonds within an iron mass. Moissan's discovery confirms this view. On the other side, the researches of Moissan and Friedel must also throw some light

* From a subsequent communication by Moissan we learn that the same varieties are found in the diamond-bearing earth at the Cape.

† See Recent Science, in Popular Science Monthly, October, 1892.

upon the great questions raised by Mendeléeff as regards the probable presence and prevalence of iron and carbon compounds in the interior of the globe, the formation of naphtha out of these compounds, and other extremely interesting geological questions.*

The artificial reproduction of the diamond must also be viewed as a further step in a long succession of researches which have been lately pursued for artificially reproducing all sorts of minerals, the formation of which had long remained a puzzle for mineralogists. The silicates which were formerly considered as impossible to reproduce in the laboratory have yielded within the last few years before the efforts of the chemists. Sarrasin, Hautefeuille, and especially Friedel, have reproduced different varieties of the chief constituent mineral of our crystalline rocks—feldspar—and the artificial crystals are absolutely identical with those found in Nature. Hornblende, which had long defied the efforts of the explorers, has been finally obtained in 1891 by K. Chrustchoff, after he had spent seven years in unsuccessful attempts; † but in order to reproduce it he had to heat its constituent elements for three months at a temperature of nearly 1,000°. The importance of a high temperature for further achievements was rendered still more evident in Frémy's successful reproduction of the ruby. The ruby is, of course, quite different from the diamond. Like the sapphire and the corundum, it is nothing but alumina—that is, a compound of two atoms of aluminium with three atoms of oxygen, colored by some impurities in red, in blue, or in brown. But for a long time alumina would not crystallize in our laboratories. Later on, Frémy obtained a very fine dust of rubies; but when he submitted the constituent parts of the ruby to a temperature of 2,700°, and maintained the same temperature for one hundred consecutive hours, he was rewarded by full-sized crystals of the precious stone, big enough and in sufficient numbers to have a collar made of them. And, finally, the investigation of Friedel, Le Chatelier, and especially F. Fouqué and Michel Levy, who reproduced a micaceous trachyte containing feldspar, spinel, and mica, demonstrated the necessity of resorting to a high pressure in addition to a high temperature.

To extend the range of high temperatures hitherto obtained, and to devise a means of measuring them, was thus the first condition for further progress in the reproduction of minerals and gems. But the measurement of high temperatures is a very difficult problem which has much occupied of late several prominent physicists and chemists. A thermo-electric thermometer, made of two very resistant metals (platinum and an alloy of platinum

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* See, in Mendeléeff's Principles of Chemistry, the footnotes to the chapters on carbon and iron.

† Comptes Rendus, 1891, tome cxii.

with rhodium), and graduated with the aid of the air thermometer, finally came into general use, and it proved to be quite reliable—but only up to 3,000° Fahr.,* which temperature was soon surpassed. Then, Le Chatelier devised a pyrometer based on the variations of intensity of light of fused metals at different temperatures, and this instrument again proved to be sufficiently accurate up to 3,600°; but this last temperature, too, is now surpassed by Moissan, by means of his new electric furnace, which is a real model of efficiency and simplicity.† It consists of two superposed bricks, made of quicklime, or of an especially pure calcinated magnesia. A groove with a small cavity in its middle (large enough to receive a small crucible) is made on the upper face of the lower brick in the sense of its length, and two carbon electrodes are introduced from both sides into the groove. As soon as they are connected with a dynamo machine the electric arc appears between their extremities, and an immensely high temperature is produced in the cavity. Thus, a small Edison machine, worked by a gas engine of eight horse power, gave a temperature estimated at about 4,500° Fahr., and with a fifty-horse-power engine the enormous temperature of about 5,400° (3,000° C.) was reached.

The effects of this little furnace are simply wonderful. At about 4,500° lime, strontia, and magnesia are crystallized in a few minutes. At 5,400° the very substance of the bricks is fused and flows like water. Oxides of various metals which were considered as quite irreducible are deprived of their oxygen in no time; nickel, cobalt, manganese, and chrome oxides can be reduced at a lecture experiment, and a piece of 120 grammes of pure uranium is obtained at once from the uranium oxide. At about 4,050° pure alumina is fused and little rubies are formed; true, they are less beautiful than those of Frémy, but the whole experiment lasts less than a quarter of an hour. At a higher temperature alumina is even volatilized, and nothing is left of it in the crucible. In short, the results are as interesting and as promising as those which Pictet and Dewar have witnessed when they went to the other end of the thermometric scale and produced the extremely low temperatures of about 200° C. below the freezing point.

And, finally, Moissan's discovery establishes a new link between the processes which we obtain in our laboratories and those which are going on in the celestial spaces, in the formation of meteorites. It was known long since that these masses of silicates and nickeled iron which travel in the interplanetary

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* C. Barus in Philosophical Magazine, fifth series, xxxiv, 376; L. Holborn and W. Wien n Wiedemann's Annalen, xlvii, 107.

† Comptes Rendus, December 12, 1892, tome cxv.

spaces and, entering occasionally into the sphere of attraction of the earth, fall upon its surface, sometimes contain charcoal or a special variety of graphite; but later on, in 1887, the St. Petersburg Professors Latchinoff and Eroféeff went a step further and proved that the charcoal is occasionally transformed into diamonds; thus they extracted some diamond dust from the meteorite fallen during the previous year at Novo Urei, in the province of Penza. Some doubts were, however, entertained as regards their discovery, but the fact has been fully confirmed since by Friedel and Le Bel, who found in a meteorite from Cañon Diablo minute diamonds and carbonados exactly similar to those of Moissan.*

It is thus evident that the artificial reproduction of the diamond is not one of those accidental discoveries which may be made without leaving an impression upon science for many years to come. It is only one of the many advances made in a certain direction, and is the outcome of the whole drift of modern research which endeavors immensely to widen the means at our disposal for effecting physical and chemical transformations of matter. It is one step more into a new domain where chemistry, metallurgy, and mineralogy join hands together for revealing by joint efforts the secrets of the constructive forces of matter.

The study of the direct action of environment upon organisms, and of the mechanism of its action, becomes a favorite study among biologists—the "transformists" being no more a few exceptions in science, but already constituting a school which has several brilliant representatives in America, France, and Germany, as well as in this country. It is evident that almost none of the biologists engaged in this kind of research maintains any doubts as to the importance of natural selection as a factor of evolution. To use the words of one of the leading American transformists,† "the law of natural selection is well established, and no more under discussion." For many adaptations it offers the best and the only possible explanation. But biology would have been brought to a standstill if the idea had prevailed that, after a more or less plausible explanation of some adaptation has been given under the hypothesis of natural selection, nothing more is left to be done to explain this same adaptation. For many animals whose manners of life we hardly know at all—the study of animal life having been deplorably neglected for the last fifty years—the explanation would often be little better than a mere hypothesis; but

* Comptes Rendus, December 12, 1892, tome cxv, p. 1039; also February 13, 1893.

† H. F. Osborn, whose admirable essays, mentioned in a previous review, are now published in book form.

even in the best cases the very origin of each variation would still remain to be found. Darwin fully understood this necessity; and the physiological and mechanical origin of variations is what so many biologists are now working at. Several such investigations are already well known to English readers through the works of Cope, Semper, Lloyd Morgan, J. T. Cunningham, and P. Geddes. Many others ought to be analyzed and discussed; but for the time being I can only mention a few recent works relative to the origin of animal colors.

Wherever we go we see animals colored in accordance with their surroundings. White and light gray colors predominate in the arctic regions; tawny and yellow colors in the deserts; gorgeous colors in tropical lands. The striped tiger in the jungle is hardly recognizable among the shadows of the tall grasses. Insects resemble the flowers which they usually visit; caterpillars have the colors and often the forms of the twigs and the leaves they feed upon. Dusty-colored nocturnal insects; moths which take autumnal tints if they begin life in autumn; dark squirrels in the dark larch forests, and red squirrels in the Scotch-fir groves; animals changing their color with the season—all these are familiar instances. But are they all due to natural selection alone? Does not environment take some part in itself producing these colors?

In a very suggestive work*, Alfred Tylor has shown in how far the different markings and the diversified coloration of animals follow the chief lines of structure; and A. R. Wallace has readily admitted that, while the fundamental or ground colors of animals are due to natural selection, the markings are probably due to internal physiological causes.† Coloration responds to function; and there is a law in the distribution of colors and the development of the markings, while there ought to be none under the hypothesis of selected accidental variations. Wallace goes even a step further, and shows that those birds possess the most brilliant colors which have developed frills, chests, and elongated tails, or immense tail-coverts, or immensely expanded wing feathers, all appearing near to where the activities of the most powerful muscle of the body would be at a maximum. He considers "a surplus of vital energy," increased at certain periods, as a *vera causa* for the origin of ornamental appendages of birds and other animals. And it is difficult to examine these and like facts without coming to the same conclusion.

But if partial vigorous coloration is so much dependent upon vital energy, is it not possible to suppose that the decoloration of animals with the approach of the winter is in some way connected

* Coloration in Animals and Plants. London, 1886.

† Darwinism, p. 288 *et seq.*

with a decrease of vital energy, especially if we take into account the permanent white colors of domesticated animals in arctic regions (such as the Yakutsk horse), which can not be dependent upon natural selection? Some recent observations give a certain support to this supposition. Thus we now learn that rabbits which have been taken to the Pic du Midi Observatory (9,500 feet above the sea level) have given in seven years a race somewhat different from their congeners in the surrounding plains. They are a little smaller, have less developed ears, and their fur coats are of a lighter color and very thick. Moreover, the very consistence of their blood has undergone a notable change. It contains more iron, and possesses a greater power of absorption for oxygen.* An anatomical change is thus produced by the environment; and no naturalist will doubt that, if the race continues to multiply for a great number of years in the same conditions, it will maintain its present characters or develop new ones on the same lines, the more rapidly so if natural selection eliminates the less adapted individuals.

A few more additions in the same direction may be found in a valuable work recently published by F. E. Beddard.† Thus, he mentions the researches of Dr. Eisig,‡ who has endeavored to explain the ground colors of some animals as dependent upon their food, and has shown, for instance, that the yellow color of an annelid which is living on a yellow marine sponge (a color which might be explained as protective for the parasite) depends upon the yellow pigment of the sponge absorbed by the annelid. The prevalence of crimson colors among some fishes in a certain part of the New England coast, which is covered with scarlet and crimson seaweeds, is explained by J. Browne Goode by the red pigment derived by the crustaceans from the algæ with which their stomachs are full, the crustaceans being devoured by the fishes. And the experiments of Mr. Guyson relative to the effects of different food plants upon a number of species of moths, as well as those of Mr. J. Tawell upon important modifications produced by food in the larvæ of the large tortoise-shell butterfly, both mentioned in the same work, are attempts in a most important but very young branch of experimental morphology.

Another series of researches is now being made with the view of more deeply penetrating into the physiological causes of animal coloration. Thus, it is a fact well known to fishermen, and now

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* Comptes Rendus, January 2, 1891, tome cxii.

† F. E. Beddard, Animal Coloration; an Account of the Principal Facts and Theories relating to the Colors and Markings of Animals, London, 1892.

‡ Fauna und Flora des Golfes von Neapel: die Capitelliden, quoted by Mr. Beddard, *loc. cit.*, p. 101.

confirmed by direct experiment, namely, by Westhoff, that several fresh-water and marine fishes change their color from white to dark as soon as they have been transferred from a medium with a light-colored bottom to another medium the bottom of which is dark. Fishermen, we are told by Mr. Poulton, even keep their bait in white-colored vessels in order to make it assume a lighter color. The common frog also can change its color to some extent in harmony with its surroundings, while the green tree-frog of southern Europe was long since known for this capacity. It is bright green among green leaves, and dark green when seated on the earth or among brown leaves.* Like changes are also known in the chameleon and in some South American lizards. The causes of these changes have already been investigated by Pouchet in 1848 and Brücke in 1852, but now we have a more elaborate research by Biedermann † upon the same subject. He has discovered three different layers of cells which contribute to give the frog its varying colors. There is first, deeply seated in the skin, a layer of pigment-cells which contain black pigment both in their interior and in their ramified processes, spreading within the skin. These cells are covered by a second layer of "interference-cells" containing bright yellow granules as well as granules of a pigment which sometimes appear blue or purple, and sometimes gray—the whole being covered with a transparent outer skin. The normal green color of the frog is produced by a combination of blue and yellow interference-cells appearing on a black background; but if the black pigment of the deepest layer is protruded into its ramifications, the color of the animal becomes darker; and if it retires deeper, the yellow granules of the middle layer become more apparent, and the frog assumes its lemon-yellow color. Finally, when the yellow pigment gathers into round drops between the bluish interference-cells—not above them—the skin acquires a whitish-gray tint. The same arrangements exist in other reptiles and amphibia.

Now, how is it that the cells change their position in various lights? Is it some reflex action in the nervous system, as it appears in fishes, which cease to change their color when they become blind? Or have we to deal with some direct action of light? Facts are in favor of the second explanation. The slightest change of temperature affects the mutual disposition of the pigment-cells, and consequently the color of the frog; it is enough to keep the animal in the hand to provoke a contraction of its black cells. The amount of blood-supply also has a definite effect;

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* E. B. Poulton, Colors of Animals, London, 1890, p. 82 *et seq.*

† W. Biedermann, Ueber den Farbenwechsel der Frösche, in Pflüger's Archiv für Physiologie, 1892, Bd. li, p. 455.

as soon as a certain part of the skin receives no more blood, the color-cells receive less oxygen, the black cells contract, and the animal assumes a lighter color. But the effects of light are even more interesting. Pouchet had shown that those fishes which usually adapt their color to their dark or light surroundings cease to do so when they have lost sight; they remain dark even in light surroundings.* The indirect effects of light through the intermediary of the visual organs are thus certain. But Steinach† has proved that light acts in a direct way as well—perhaps, we may add, in the same way as it acts upon the chlorophyll grains of the leaves. He glued strips of black paper to the skin of frogs which were kept in the dark, and when these animals were exposed to light, only the open parts of their skin returned to a lighter color, while the covered parts remained dark. To avoid all doubts, the experiments were repeated on skin separated from the body, and photograms of letters and flowers, cut out of black paper and glued to the skin, were reproduced upon it. Besides, blind tree-frogs do not darken as the fishes do, and Biedermann has proved that the chief agency of their changes of color is not in the sensations derived from the eye, but in those derived from the skin. Frogs, whether blind or not, become dark green, or black, if they are kept in a dark vessel in a sparingly lighted room. But when a larger branch with green leaves is introduced into the vessel, they all recover their bright-green color, whether blind or not. In some way unknown, the reflected green light acts either upon the nerves of the skin, or, what seems more probable, if Steinach's experiments are taken into account, directly upon the pigment-cells. Moreover, the sensations derived from the toes have also an influence upon the changes of color. When the bottom of the vessel is covered with felt, or with a thin wire net, the frogs also become black, recovering their green color when a green branch is introduced in the vessel.

We have here temporary changes of color produced by the surroundings; but various gradations may be traced between the temporary and the permanent changes. Thus Lode provoked local contractions of the pigment-cells in fishes by electrical irritations applied locally. And Franz Werner's researches upon the coloring of snakes, recently embodied in a separate work,‡ show that the temporary and irregular spots which appear in fishes and frogs under the influence of artificial irritations are of the same

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* Direct observations have been made also by Alois Lode (Sitzungsberichte of the Vienna Academy, 1890, vol. xcix, 3te Abtheilung).

† Ueber Farbenwechsel bei niederen Wirbelthieren, bedingt durch directe Wirkung des Lichtes auf die Pigmentzellen, Centralblatt für Physiologie, 1891, Bd. v, p. 326.

‡ Franz Werner, Ueber die Zeichnungen der Schlangen, Wien, 1890.

character, and have the same origin, as the also temporary and irregular spots which appear in other fishes, as well as in several tritons and many Gekonides, without the interference of man. Some of the provoked changes of color do not entirely vanish after the irritation is over, and they belong to the same category as the spots which appear in many animals in youth, and disappear with growing age. Moreover, it is maintained that a series of slow gradations may be established between the irregular spots, the spots arranged in rays, and finally the stripes, such as we see them in higher mammals like the zebra or the tiger; and if these generalizations prove to be correct, we shall thus have an unbroken series, from the temporary spots provoked by light or electricity to the permanent markings of animals.*

And, finally, attempts are being made to explain some of the wonderful so-called adaptive colors of insects as a direct product of environment. Some time ago (in 1867) T. W. Wood published experiments upon the larvæ and pupæ of both the small and the large cabbage butterfly. He kept the larvæ during their metamorphoses in boxes lined with paper of different colors, and he found that the colors assumed by the pupæ more or less corresponded to their surroundings. Later on E. B. Poulton made a wider series of analogous experiments, and he saw that the change of color is accomplished during the first hours when the larva spins its web; he came to the conclusion that it depends upon a certain physiological action which is transmitted to the nervous system, not only through the visual organs, but through the whole surface of the skin. These facts have now been fully confirmed again by W. Petersen,† but his explanation is of a more mechanical character. He maintains that the color of the pupa depends upon the pigment contained in both its cuticle and hypodermis. The pigment of the latter is green in the larva, and sometimes it remains green during the pupal stage; but it may be visible or not, according to the amount of dark pigment which is formed in the cuticle, and the amount of this dark pigment entirely depends upon the color of the light. Yellow and orange light prevents the formation of the dark pigment, and in such cases the cuticle, which remains transparent, shows the green pigment of the hypodermis. But the less bright parts of the spectrum have not the same power, and if we trace a curve representing the powers of the various parts of the spectrum for preventing the formation of a dark pigment, the curve has its

* See the polemics engaged upon this subject in Biologisches Centralblatt, December 15, 1890, and July 15, 1891; as also the Zoologische Jahrbücher, 1891.

† Zur Frage der Chromophotographie bei Schmetterlingen, in Sitzungsberichte der Dorpater Naturforscher-Gesellschaft, 1890, vol. x, p. 232.

culminating point in the yellow, and descends toward both ends of the spectrum; it exactly corresponds with the curve of assimilation of carbon by plants under variously colored light. It is also remarkable that the green color of the pupa is only obtained by yellow light, or by such green as contains yellow; such is, as known, the average color of leaves. We thus have a case where environment itself makes the color which approximately matches it.

The meaning of these researches is self-evident. No naturalist will probably attempt to explain the animal colors and markings without the aid of natural selection. But it becomes less and less probable to admit that the animal colors are a result of a selection of *accidental* variations only. The food of the organism, and especially the amount of salt in it, the dryness or moisture of the air, the amount of sunshine, and so on, undoubtedly exercise a direct effect on the color of the skin, on the fur, and on the very intimate anatomical structure of the animal. As to the relative parts which must be attributed in the origin of each separate variation to natural selection on the one side, and to the direct action of environment on the other side, it would simply be unscientific to trench upon such questions in a broadcast way, so long as we are only making our first steps in discriminating the action of the latter agency. The first steps already indicate how complicated such questions are, especially in those cases where natural selection must act in an indirect way—not as a mere selection of already modeled forms, but as a selection of forms best capable to respond to the requirements of new conditions—in which case the intimate organization of the living being comes in the first place. All we may say at the present moment is that the direct modifying action of environment is very great, and that no theory can claim to be scientific unless it takes it into consideration to its full amount.—*Nineteenth Century.*

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Mr. W. Roe, of the Cape Colony, has pointed out a disadvantage connected with irrigation. Most water used for the purpose contains variable quantities of soluble salts, some of which are not taken up largely by plants. Every application of water, therefore, adds to the saline ingredients of the soil—a very different effect from that of excess of rain water, which, so far as there is open subsoil for it to drain away, would be likely to take out rather than add to the soluble salines in the soil. The mischief of the accumulation of salts in the soil is aggravated in a dry-air land where evaporation is great. The air, acting like a sponge on a surface, takes up the water, leaving the accumulated salts in the surface soil. But this surface soil is as the sponge to the layer beneath. Constantly after each water-leading, the water is drawn to the surface and evaporated, leaving the accumulated salts in the surface soil. The harm done by this accumulated salt will depend on the nature and quantity of the salines in the water used, as also upon the quantity of water supplied.

# THE PILGRIM PATH OF CHOLERA.

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WITH cholera steadily creeping toward our shores, and all Europe standing armed against the invader, it becomes a matter of the extremest interest to inquire how the disease escapes from its home in India, under what influences it becomes able to break its bounds, invade the outer world, and carry death and devastation into countries where not only has it no natural home, but where it is so far an exotic that even after repeated attempts it fails to become acclimatized.

India is the endemic home of cholera, and from some parts of that great country it is seldom entirely absent. In 1881 there were in India 161,000 deaths from cholera; in 1887, 488,000; in 1888, 270,000. The heat, the moisture, the necessity of drinking stored water, and the habits of the people which make that water foul, all combine to plant firmly in the district a contagium like that of cholera. For the living infection, the *contagium vivum* of this disease, enters man's body in the water which he drinks, while in return it enters the water by means of the sick man's discharges. A vicious circle is thus set up. Given a temperature and perhaps a condition of water in which this contagium can retain its vitality outside man's body, and a state of society in which the fouling of the water and the drinking of it when foul are daily habits, and we have before us the essentials necessary to render the disease endemic.

Whether this living contagious matter be a bacillus or a spirochæte is almost beside the present question, and under what circumstances of water and soil it grows and propagates, or merely rests, is again for our present purpose not of much importance. What is certain and what is of extreme importance is that incontestably within the human body it grows enormously; that every individual sufferer from cholera is constantly discharging an untold multitude of contagious particles, which are capable of again setting up the disease afresh in any one by whom they are swallowed; and therefore that if these contagious particles are swept by rain showers into streams or wells, or if the water in which linen soiled by them is washed percolates into tanks or ponds, the water so fouled is specifically poisonous and will produce cholera in those who drink it, just as arsenic mixed in water will produce arsenical poisoning.

It is a matter of surprise to many, who have the proofs of this vicious circle nakedly before them, that the truth so long lay hidden, and that even yet men who have lived much among chol-

era, and who have had large experience of it, should hesitate to admit the fact that the way in which the infection parted with by the one sufferer gets round to another is by the water which the one man fouls and which the other drinks. But, as a fact, those who dwell in the midst of an endemic area, although they may have exceptional opportunities for studying the disease itself, its symptoms, its treatment, and its pathology, are not always so well placed for the investigation of its mode of dissemination as those whose lot is cast in places where the disease is but of exceptional occurrence. In an endemic area the chances of infection are so various and complicated, the difficulty of eliminating other modes of access so enormous, that it is often hard in the extreme to prove the particular route by which the malady has reached its billet. In non-endemic areas, however, things are very different. The disease may not have appeared in the district for months or years; the source of the infection, the first in-carrier of the disease, may usually be known at once, and all his previous doings may be ascertained. With patience every mode of contact or communication between the first and subsequent sufferers may be traced out, free from the interfering influence of possible infection from other sources covert and concealed all around. Thus it happens that much of our most useful knowledge on the subject comes from the investigation of the disease as it has appeared in isolated epidemics rather than in endemic areas.

For Dr. Snow, of London, I must once more claim the great honor of being the first to recognize water as a medium of disseminating cholera. His deductions to this effect, from his observations of cholera in England between 1848 and 1854, were, as I have elsewhere shown, confirmed by the elaborate investigation of Farr and Simon; and in 1866, following in the same footsteps, I placed the corner stone of the edifice by tracing the disastrous cholera epidemic of that year in East London to the distribution of polluted and partially filtered water from the river Lee, by the East London Water Company—the poisonous sewage of one family distributed unfiltered for forty-eight miles. Since that startling experience, I have been convinced that specifically polluted water is not merely an occasional or adjuvant cause, but the *causa causans* of almost every great epidemic of Asiatic cholera.

The earliest important instance in which the agency of water as a disseminator of cholera was clearly demonstrated was that of the Broad Street pump in St. James's, Westminster. The first death in the parish was recorded early in August, 1854, and throughout that month a few deaths occurred each week, but during the week ending September 2d, seventy-eight deaths were registered, in the next week there were two hundred and eighty-

seven deaths, in the following week there were sixty-seven, and then the mortality as quickly subsided as it had arisen. No satisfactory solution of this mysterious outbreak presented itself until Dr. Snow was called in to examine the water supplies. His published report shows the clearly marked incidence of the disease on those who drank from the parish pump. The workers in one particular factory where the water was always used suffered severely from cholera, while those in an adjoining brewery, where the water was never touched, escaped, and numerous instances of fatal attacks of cholera following the use of the treacherously sparkling water from this pump are detailed. On the drains of the house adjoining the well being opened, it was found that there was a cesspool under a common privy, within three feet of the well, and at a higher level than that of the water in it; that the walls of the cesspool being rotten, the contents leaked into the surrounding soil; that the walls of the well were also rotten, and that there was distinct evidence of the cesspool contents having for a long time leaked into the well. Then came the startling fact that in the house itself a child aged five months had died on September 2d, of so-called "diarrhœa," but with distinctly choleraic symptoms.

In 1866 England was again invaded by cholera, and that epidemic is memorable for the terrible experiment which was unconsciously carried out by a water company at the expense of some four thousand lives in East London. Early in the outbreak I was struck by its incidence on the area supplied by the East London Water Company, and I felt confident that it could only be due to a sudden specific pollution of the water supply. Acting on behalf of a great medical journal, I dispatched the late Mr. J. Netten Radcliffe—who had not then become attached to the Medical Department of the Privy Council—to investigate the matter. After much trouble, the result showed that owing to changes having been made in their filtering apparatus, the company had sent out for a few days unfiltered water, or water in a very partially filtered state, direct from the river Lee, which had just at that moment become infected with choleraic discharges from a cottage, the sewers of which were connected with the river, and in which a family had come to reside who had reached Southampton infected with cholera and had been allowed to pass on after they were supposed to have recovered.

These things are now ancient history, and are only here repeated as an illustration of the fact that wherever a single outbreak can be isolated and examined separately, without the intrusion of cases of cholera from round about, the disease is seen to be obviously carried to the patients' mouths by the water which

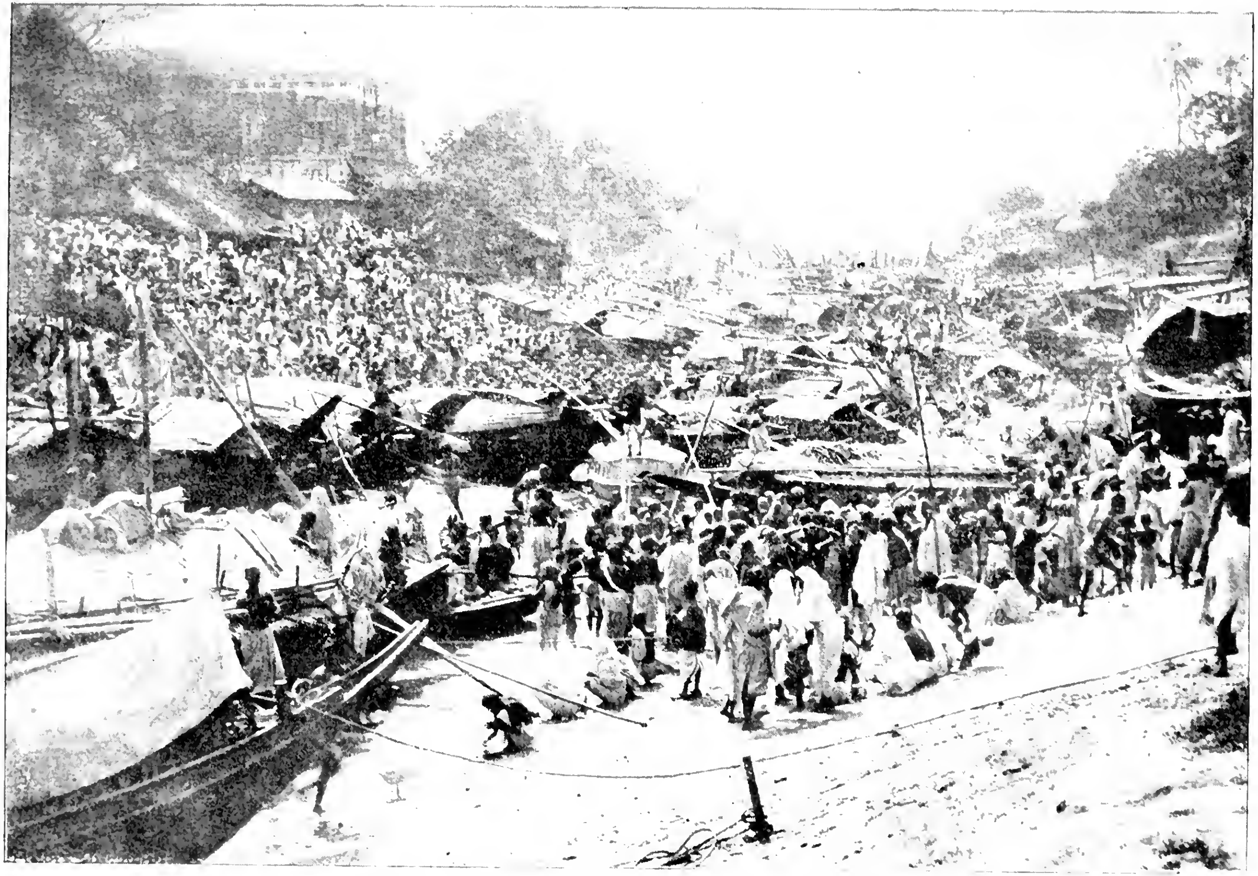

FIG. 1.—VIEW OF TOLLY'S NULLAH AND ONE OF ITS GHATS ON THE MORNING OF FEBRUARY 8, 1891.
The nullah is crowded with boats carrying pilgrims, and with pilgrims bathing in the sacred stream

they drink. The same was shown in Egypt in 1883, in France in 1884, and again in the department of Finistère almost at the present time.

In Italy, Naples has afforded one of the most striking examples of the same thing. Commencing in August, 1884, the epidemic spread by rapid strides until September 11th, and then rapidly fell. Between August 23d and November 9th some 12,345 cases and 7,086 deaths occurred among a population of 492,908. At that period the water supply of Naples was mainly derived from trenches running from house to house underground, and was exposed to direct contamination not only by soakage of filth, but by the reckless practice of washing in the trenches linen soiled by choleraic discharges.

In the following year Naples was supplied with pure water from a distant mountain stream (the Serino), and there followed a marked immunity of the city from cholera, notwithstanding the presence of the disease in the neighborhood. In 1887, however, an injury to the Serino water conduit led to a temporary return to the old system, and two sharp explosions of cholera at once ensued, but ceased on the resumption of the purer supply. Even more demonstrative was the case of Genoa, a city provided by means of three aqueducts with an excellent supply of a naturally good water. After a few scattered cases a sudden and widespread explosion of cholera occurred between September 21st and 24th, the rich and the poor being indiscriminately attacked. It was soon found that of the first three hundred cases ninety-three per cent were in houses supplied by one of those aqueducts (the Nicolay), and on following that watercourse to its commencement near the village of Busalla, thirteen miles distant, a colony of workmen was found encamped. Cholera had broken out in Busalla on September 14th, and inquiry disclosed the fact that the clothing of the workmen, both of the sick and the healthy, was washed in the river Scrivia, which feeds the Nicolay aqueduct. The supply of this water to Genoa was promptly stopped on September 28th, and the epidemic at once rapidly declined.

Everywhere the same tale is told, but my present immediate object is to insist that also in India, the "home of cholera," it is now clear—to me at least—that water is the agent by which the infection is carried from one human being to another.

The experiences of Calcutta, as observed by Dr. W. J. Simpson, the able health officer of that city, show that those persons who have an abundant and pure water supply—namely, the Europeans and better-class natives—escape cholera epidemics, except in isolated instances which can generally be accounted for; while the natives who depend on tank water suffer severely when a tank becomes polluted by the excreta of a cholera patient.

I think it capable of proof that it is on the scarcity of water, and on the habits and customs which have grown up during centuries of suffering from that scarcity, that the existence even of the "endemic area," the natural "home of cholera," depends. If this be admitted—and I think it can no longer be denied—the fact and necessary inferences from it are of vast and world-wide importance. The natives bathe and wash their utensils and clothes in the tank, because it is the only available place in which to do so, and they use the water of the tank, contaminated as it is in addition by soakage and sewage, for cooking and drinking, because it is the only water supply available for domestic purposes.

With these facts before us, and reading them in the light of our European experience, it can no longer be doubted by thoughtful and reasonable persons that the reason why, in India as in other places, some classes escape and others suffer, is that some drink pure water and others drink water contaminated with choleraic discharges.

Nor can we shut our eyes to the probability, growing stronger every year, that the true meaning of the term "endemic area," in regard to cholera, is a district in which the customs of the people sanction the drinking of fecally polluted water, and in which from temperature, and perhaps from other causes incompletely known, the cholera germ or contagium can easily keep alive and propagate itself in soil or water in the interval between its exit from one host and its entry into another.

Nothing seems more certain than that people can touch cholera patients, and rub them, handle them, and live with them, even in the midst of an endemic area, and not catch the disease so long as they take precautions not to swallow it.

This is the key to the position, the horrid truth, the dirty fact, that the bacillus, the contagium of cholera, lives two lives: one, in the human body, causing the disease, multiplying within the patient, and poured forth by him in abundance; the other, outside the body, waiting in damp ground, on soiled linen, in dirty water —waiting to be swallowed by some one else and to start again on its destructive course. How, then, does it get round? We know well enough that the outside of a cholera patient is not infectious; the infection comes from within, with the discharges; how, then, does it get into the alimentary canal? How can it get round except in what we drink?

This is what I mean by speaking emphatically of cholera being a water-borne disease. It is not that cholera is a disease of rivers and watercourses alone, but that, whether it is a matter of rivers or tanks or water supplies, or merely of wash-basins, jugs, and water-bottles, the water which the patient drinks is the vehicle by which the poison enters, and is the final step in the course of

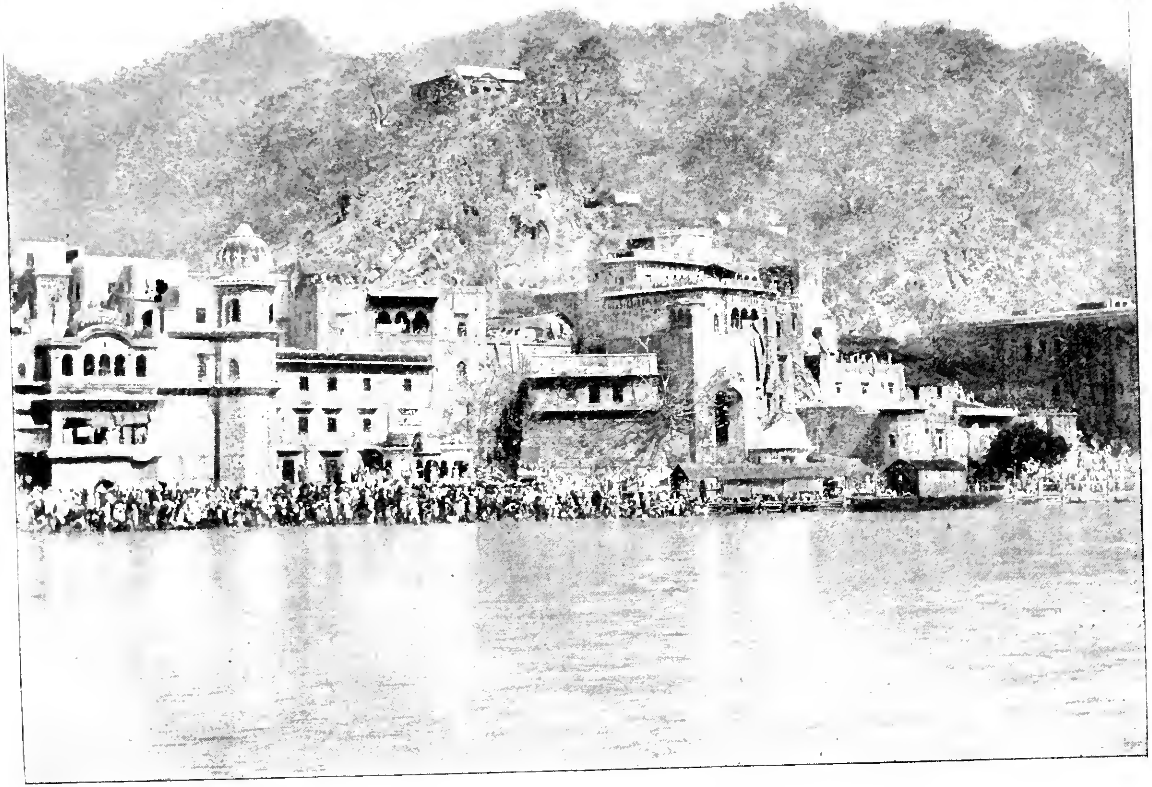

Fig. 2.—Sacred Pool at Hurdwar.

the infection from its previous breeding ground within the body of a previous patient. We now can understand why, when cholera spreads and breaks its bounds, it follows the lines of human traffic and communication. Man, in fact, is the porter by whom the cholera is carried from place to place, and so the rate of diffusion depends upon the rate of travel. But, as no one porter can carry the malady further than he can go between the time of being infected and being struck down, the wide spread of the disease depends not only on the speed of the porter, but on the sanitary condition and social habits of the place where he is taken ill; for, if these are such that he can transfer his load to others, that the infection he deposits can take root and grow in the bodies of fresh patients, some of whom may travel to fresh places and set up fresh foci of disease, the epidemic spreads; but if, from cleanly habits or clean surroundings, or from plentiful supply of pure water, the infection fails to pass from body to body, the malady dies out, and there is an end of the matter. King Cholera is, in truth, a lazy and voluptuous potentate; unless he is carried by quick steamers, he will not travel far without a rest, and when he reaches his destination he declines either to advance or show his power unless he is nourished and pampered with his beloved luxuries of dirt and filth and fecally contaminated water.

The inhabitants of the Indian "endemic area" are a conservative race—the son lives like the father; one generation passes on like another, and centuries of intermittent pestilence and famine have till lately kept down the population to exactly tally with the means of sustenance. The village community has been for ages the unit which, multiplied by thousands, has made up the population. Each village has mostly kept to itself, and, except for the wars of their rulers, the passage of their traders, and their occasional pilgrimages, they have for time immemorial lived an isolated life. At times of pilgrimage, however, all this isolation is cast aside, and pilgrims from widely scattered districts rub shoulders in the bathing places, wash and cleanse their bodies and their clothes in the same water, which in turn they drink in an unsavory fellowship.

Disease may remain for long tied up in a single village; nay, a whole village may die of cholera, and do but little damage to their neighbors; but in times of pilgrimage cholera travels with the pilgrims, and, after the festival is over, is scattered broadcast through the land. Such fairs as that at Hurdwar, at the junction of the hills and plains, outside the endemic area, but attended largely by those who dwell within, have beyond doubt been the great gateways by which cholera has periodically escaped from its confines to ravage the world at large. Of this the historic

records give abundant evidence, especially in the epidemics of 1867 and 1879.

But, spread all over the country, especially in its northern parts, there is a large Mohammedan population, from among whom there pours out an annual pilgrimage which wends its way to Mecca, the holy place which every faithful Moslem strives to reach—a pilgrimage which of late years has been a recurring danger to the Western world, having been the means of introducing to Egypt in 1866 that outbreak of cholera which carried off sixty thousand of its inhabitants in the course of three months; and of sending on to England the infection, which destroyed six thousand people in London; besides being the origin of the various epidemics which have fallen so heavily on the south of Europe, although they have not done great harm to our own more favored land.

The fairs and pilgrimages of the East constitute the danger of the West, and it is now recognized in every land that this danger is vastly aggravated by the greater rapidity of communication in these latter days. When by weary marches, or sailing in small boats, tacking day after day against opposing winds, months, nay sometimes years, were spent in the journey, those who were taken ill died in the transit; whole caravans melted away, and ships with cholera-stricken crews were lost, together with their crowded cargo of holy pilgrims, and thus the outer world was saved. But with quicker means of communication, with railways and steamboats, and the general hurry of modern life, pilgrims also have quickened their pace, and, what is most important, have lengthened the stages and lightened the labor of their journey, so that the infected ones have lived through hundreds instead of tens of miles before they dropped, and have thus surmounted the barrier of desert and of sea by which Europe was formerly protected. No longer does cholera necessarily sneak round by Russia and the Caucasus, infecting the various resting places on its way, and setting out again as opportunity arises and as caravans and travelers may serve. At one bound it is in Jiddah. Mecca becomes a center of infection, and Red Sea ports distribute the disease to Egypt and the south of Europe.

Ordinary traffic can be watched, and by medical inspection cases of disease can be picked out and isolated; but with a sudden crowding of sixty thousand people devoid of all sanitary knowledge into a country ill equipped with sanitary appliances, governed by rulers whose chief principle and guide is a fatalistic trust in the will of Allah, the problem is complicated in a high degree.

It must not be forgotten that the spread of cholera is not entirely due to the infection carried by those who are attacked. No

man can carry it more than one stage, and whether or not it starts again from the place where he deposits the infection depends on the sanitary conditions of the locality and the customs of the people. There is but little doubt that the danger caused by the Mecca pilgrimage to the health of Europe depends largely on the fact that from the recklessness of the people and the absence of adequate sanitary arrangements in the district, Mecca has become a great central fair for the exchange and distribution of the cholera infection.

In 1886 thirty thousand pilgrims died of cholera at Mecca. Nor can we wonder. Everything seems to be done to destroy their tone and their resisting power; everything seems to be arranged to spread the disease when the infection is once planted amid the host of pilgrims.

From seventy to a hundred thousand seems to be the ordinary average number of those who visit Mecca during the festival, and who are present at Mount Arafat on the 9th of Zu'l Hijjah. They come from every quarter of the compass—inland by caravan from Syria and Persia, Turkey and Afghanistan; by sea from Red Sea ports; from Africa, across the whole width of which many of the weary pilgrims have walked; and from every part of the world where the standard of Islam has been raised. With no provision for decency or comfort they camp around or crowd into lodgings in the sacred city. They make excursions, clamber up the mountains, spend hours in the blazing sun, are sickened with rotting smells arising from the thousands of animals which are sacrificed; crush and stifle in the Ka'ba; and, finally, as if they had not already run sufficient risk of catching every possible complaint, they drink the water of Zem Zem. This is the well from which Hagar is said to have drawn water for her son Ishmael, and the drinking of the water is a most holy rite. The supply, however, is not as great as could be desired for so large a crowd of pilgrims, and the manner of dealing with it at the well goes far to explain the intensity of the poison and the fearful mortality which attends any outbreak of cholera among the Meccan pilgrims. At a given period the pilgrims stand naked in turn at the place appointed: a bucket of water is poured over each man; he drinks what he can of it, and the rest falls back into the holy well. The water from this well has been analyzed by Dr. Frankland, F. R. S., of the Royal College of Science, London, who describes it as fearfully polluted with abominable contaminations. Imagine, then, one single member of this enormous crowd to be suffering from the early stage of cholera; to be struggling, as struggle he would with his last strength, to get through the holy rite, and to be allowing the choleraic discharges with which his body would be soiled to be washed back into this foul well.

Fig. 3.—Approach to the Sacred Pool of Hurdwar, with Pilgrims bathing.

What is to happen to the crowd of pilgrims who close in on the spot that he has left, and who, each in turn, swallow in rapt fervor the fetid draught in which these thousands have been washed? Can we wonder, then, knowing the history of the Broad Street pump, that in 1866, within a few days of the ceremony, the road leading from Mecca was for twelve miles thickly strewn with dead bodies—a holocaust to be added to the account of perverted religious rites which has already so deadly a record?

Gradually England is undertaking the gigantic task of not only ruling India—a thing to which India has been accustomed for untold centuries—but of reforming and remodeling her habits and her customs, a thing hitherto quite unknown, untried, and thought by many to be impossible. A stolid mass of conservatism of habit and even of thought has to be moved, and has to be so moved as not to drift into anarchy and reaction. This is a long, slow, tedious process. The existence of the "endemic area," the "home of cholera," depends largely on the persistence of habits and modes of life which can hardly be rooted out. If they are to cease, they must probably die away or be slowly crushed out rather than be swiftly overturned. We may at once make up our minds that if the safety of Europe can only be attained by abolishing cholera in India, Europe will for long remain in danger. It is hard to say how long: the object of this essay is to abridge the period to the utmost. To those, again, who know best the condition of the towns in the south of Europe it seems an almost equally far-off hope to expect them within any reasonable time to reach such a condition of cleanliness and sanitary preparedness as to be able to look calmly on the approach of the dread disease. But this is a much less formidable and more hopeful task, when once it is courageously and persistently faced. Are we meantime to stand helpless? Can nothing be done to stop the infection on the way? Not so. In the matter of ordinary travelers isolation of the infected need not be insuperably difficult. The individual attacked may be sent to a properly equipped hospital, be surrounded by a true *cordon sanitaire* in the modern sense—not a ring of gendarmes or a circle of quarantine as of old, but *an area of sanitation,* within which cholera can not spread. Within this area the disease may expend its force with injury to no one and the crisis pass without danger to the country. But the case of the pilgrims is different. Fairs and pilgrimages of India differ from other means of spreading the disease in this, that not only do they draw people from all parts and thus increase the chances of receiving the infection, but the people attend them in such numbers that they support each other in carrying on their own customs, the very customs which have for centuries conduced to the spread of the disease in cholera's home. It is as if the fair or

the pilgrimage were not only supplied with a proper dose of the infection, but were provided with a plot of the "endemic area" on which it could be grown. In bedding out a plant we do not put its naked roots into the new inhospitable soil, but we place in the new ground a portion of the mold in which it hitherto has grown, so that its tender rootlets may gradually get accustomed to their new surroundings. And the fairs and pilgrimages of India do much the same to plant the cholera in the new localities. The infection carried from the endemic area can not die out, even although it be but an exotic in a strange land, because the people carry with them also the habits and customs which are conducive to its growth, the willingness to use the same water for every purpose, the readiness to drink it when in its foulest state.

In a report in June, 1891, Dr. W. J. Simpson, of Calcutta, gave a picturesque and startling account of two large pilgrimages which he personally witnessed in that year—one in the endemic area of Bengal, and another in the non-endemic area, or north part of India. A pictorial presentation of one of their chief features, which I am able to give from private photographic plates that he has furnished me, will show the condition more effectively than merely verbal discussion.

The first of these was the Ardhodoya Jog, which comes round at rare intervals, happening only when the moon is in conjunction with the sun in a certain latitude of the Indian zodiac. This event, it appears, only occurs once in twenty-seven or twenty-eight years, and is then made the occasion for a great bathing festival. The purity to be obtained by bathing in the Ganges during this festival is exceptionally great, and therefore the gathering of pilgrims at the several bathing grounds was a very large one.

Kalighat, where the gathering in question took place, is the suburban area of Calcutta, on Tolly's Nullah, a small tidal creek which is held to be more sacred than the Hooghly, because it is believed to be one of the original beds of the Ganges which has gradually silted up. Sanctity, however, in these parts is no assurance of decency. Along its banks on both sides houses and huts are built, the drainage from the latrines of which finds an easy and convenient outlet into the streamlet. Soiled clothes of the sick and healthy are washed here; oxen, buffaloes, horses, goats, and other animals take their bath in the water; and as the nullah has frequently passing through it many country boats, the boatmen add to the general pollution.

Kalighat, like the other suburbs of Calcutta, also possesses a large number of tanks or ponds, round which the huts or houses of the inhabitants are built, and which are the drainage cesspools of the locality. Much has been said concerning the filthiness of

these tanks. Their contents more or less resemble pea-soup in color, and their composition has been officially reported as similar to concentrated London sewage. Those conversant with the uses to which these tanks are put will not be surprised at this statement. And yet these ponds of filth are constantly resorted to for the cleansing of utensils and the soaking, maceration, and washing of the rice and *dahl*, and in the preparation of sweetmeats.

The nullah can be waded across at low tide, but it is the receptacle of unspeakable filth of all kinds. After describing the insanitary arrangements of the neighborhood, Dr. Simpson remarks that "without a good water supply, or drainage, or proper means of disposal of the excreta and sulliage, with crowding together of huts and houses irregularly placed, and with the filthy tidal nullah, which is practically the sewer of the district, and with numerous polluted tanks, Kalighat, it may be surmised, is at no time a healthy spot, and at all times a danger to pilgrims." On the occasion in question at least 150,000 people came into Calcutta in the first and second weeks in February. Great throngs came on foot whose numbers were not noted, 25,000 came by boat up the nullah, 90,000 came by the Eastern Bengal State Railway, and 32,000 by the East Indian Railway. Obviously the influence of railways in intensifying the danger of quick and wide diffusion of cholera after great festivals must not be neglected.

To describe the crowding which occurred in the nullah on the festival day is difficult. Perhaps the accompanying photographs will give some idea of the scene, and of the recklessness with which the filthy water was being bathed in and splashed over the head and even drunk. A large proportion of the pilgrims would not drink filtered water. They had come, they said, to bathe in and drink Ganges water, and they would have none from the standposts or the carts. Happily, the tube-well near the police station was not considered unholy, and was in lively requisition. The picture shows the crush to be very great, and it is marvelous that no accidents happened.

Among the large number assembled there it was not likely that cholera would be entirely absent, and if present it was certain to be spread by the customs of the festival, and thus it happened that in the second week in February nearly two hundred of the pilgrims died from cholera. The pilgrims soon had to be dispersed, and though their dispersal checked a larger outbreak at Kalighat, which would only have widened its circle afterward, it could not prevent those already infected from suffering on their way home. Consequently, at some of the railway stations sick people had to be taken out of the trains; passengers by boat died on their voyage, their bodies being thrown overboard; while travelers on foot were picked up dying or dead on the roads.

Fig. 4.—Pilgrims swarming around the Sacred Pool at Hurdwar.

To the pilgrims themselves the festival turned out a disastrous affair, but later investigation showed that in many villages to which they returned the residents also were affected, and that in at least three districts widespread epidemics were set up.

Such is a pilgrimage within the "endemic area," where perhaps it may be said that the danger in regard to cholera may be measured by the deaths, the dissemination of the infection through a population already charged with it not being of great importance.

But any Indian pilgrimage, even in a non-endemic area, has much the same characteristics. Dr. Simpson's description of the great Kumbh festival, which occurs once in twelve years at Hurdwar, outside the endemic area, is also very graphic, and the photographs (Figs. 2, 3, and 4) show the sacred pool and the approaches to it to be hidden by a mass of semi-naked human beings. The pollutions to which the sacred pool is exposed on these occasions are indescribable. There are not only the washing of the sacred fakirs, who cover themselves with wood ashes as their only clothing, and the general bathing of the pilgrims, who are not all in the cleanest of clothes—several, moreover, on the occasion in question being seen bathing with skin diseases upon them—but the ashes of deceased relatives brought from the different homes of the pilgrims, and the hair of widows who have been shorn, are also thrown into the water. The stream, usually so bright and pure, soon became a muddy one, offensive to the senses, and, although outside the endemic area, bacteriological examination of this defiled water showed it to contain the comma bacillus, which is looked upon as the true contagium of cholera.

With these pictures in our minds of what an Eastern pilgrimage means, and of what is done at the great festivals, whether of Hinduism or Mohammedanism, can we wonder that they are so constantly the means of lifting cholera out of its ordinary endemic character and spreading it over the world at large? In old times when cholera marched overland its route could almost be dotted out by the fairs which it infected. Now, with more rapid means of communication, Mecca, with of course Jiddah its port, is the half-way house, the halting place, the one spot at which it must be caught and stopped if Europe is to be protected. Hither tend pilgrims from all parts, including those from the infected area; here are performed rites which involve of necessity the wide spread of the infection among the visitors, if even perchance but one of them bring with him the disease; hence in a fortnight's time is scattered this great host, carrying with them the germs of pestilence to their homes in distant lands. Mecca is a peril to Europe, and at all cost Mecca must be made a sanitary area, in which cholera if it should arrive can play itself out, and from

which no infection shall be allowed to be exported. It is, however, idle to expect a Government such as that of Turkey spontaneously to undertake the task. The affair is too expensive to be undertaken by a ruler to whom ready cash is worth more than prospective suffering. Nor would his people support him in such a crusade. To them Allah is great, and cholera is his will; nor perhaps does the evil seem to them so grievous as it does to us. To those who have to suffer Turkish rule a little cholera now and then may seem but a flea-bite.

It seems probable that no single nation can effectually interfere, although if any one nation could do so, it would be England or Russia. The danger belongs, however, to Europe; and if anything is to be done, Europe collectively should take action without delay, with the aim to cleanse the ports of the Red Sea, reorganize Mecca and its greedy crew, and supervise the pilgrims in all their course.* With the increasing care, and the increasing intelligence with which that care is being exercised, in regard to cholera in Europe, and with the facilities given by the telegraph for watching the progress of cholera when it approaches *via* Russia, and the growing willingness shown by that great state to block the way when it invades her vast dominions, the Red Sea remains the route from which Europe and America have most to fear, and Mecca with its insanitary surroundings, its filthy rites, its crowds of devotees, stands as the half-way house between Europe and the home of cholera. Can we not for once think of the good of man rather than of nations? With railways and steamers linking us so closely in one family, we can no longer afford to fold our arms and look with indifference even at the strange

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* There are many indications that such representations, made in a suitable manner and by authoritative personages to the Sultan, would be warmly backed up, not only by his own personal feelings and sentiments, but also by those of an enlightened and considerable portion of his subjects. The Scotsman of January 6th says: "Queen Victoria having the largest number of Mussulman subjects, the Government of Bombay was some years ago moved by the hardships and mortality to which so many of them were exposed on the pilgrim voyage to Mecca every year. A contract was accordingly made with Messrs. T. Cook and Sons, under which the Hajjees are conveyed to and from the Red Sea ports in safety and comfort. But that avails little if they are to perish from the filth of Mecca itself, and take from it those cholera germs which they spread all over eastern Europe and Asia." Encouraged by an article on the subject in the Nineteenth Century, written by Mr. Ernest Hart, the Mohammedans of Madura, near Cape Comorin, have held a public meeting and memorialized his Imperial Majesty the Sultan of Turkey "to adopt suitable measures for improving the sanitation of Mecca and other places of pilgrimage." They make the sensible suggestion that every year during the Hajj the leading Hajjees from every country should meet and draw up a report on the state of the city and shrine to the Sultan and ask for the needed reforms. If the Sultan were not afraid of another war with the Shereef, who is the real master of Mecca, he would insist on such a share of the pilgrim fees and offerings as would make Mecca the healthiest place in his dominions.

doings of poor fanatics of Mecca. Such is the solidarity of the modern world that at the present moment it is the doings of these people, who seem so far away (geographically thousands of miles, socially and as regards their sympathies and interests quite in another sphere), which threaten us now with a repetition of such epidemics as that which not so many years ago carried off one in every forty-seven residents in Whitechapel, one in fifty-seven in Ratcliffe, one in sixty-seven in Rotherhithe, and which only last year killed off people in Hamburg at the rate of two hundred to three hundred per day for weeks together.

This is no fanciful speculation, applicable only to days gone by. Last month five thousand pilgrims died in Mecca; their infected and scattered companions are reaching Jiddah and El Tor, and are spreading over the world to their various homes. To them we may look with fear and doubt for the probable initiation of an epidemic in Europe, to follow close upon the footsteps of that which is now at our doors.

## GRANDFATHER THUNDER.

By ABBY L. ALGER.

DURING the summer of 1892, at York Harbor, Me., I was in daily communication with a party of Penobscot Indians from Oldtown, among whom were an old man and woman, from whom I got many curious legends. The day after a terrible thunderstorm I asked the old woman how they had weathered the storm. She looked searchingly at me and said, "It was good." After a moment she added, "You know the thunder is our grandfather?" I answered that I did not know it, and was startled when she continued: "Yes, when we hear the first roll of the thunder, especially the first thunder in the spring, we always go out into the open air, build a fire, put a little tobacco on it, and give grandfather a smoke. Ever since I can remember, my father and my grandfather did this, and I shall always do it as long as I live. I'll tell you the story of it and why we do so.

"Long time ago there were two Indian families living in a very lonely place. This was before there were any white people in the land. They lived far apart. Each family had a daughter, and these girls were great friends. One sultry afternoon in the late spring, one of them told her mother she wanted to go to see her friend. The mother said: 'No, it is not right for you to go alone, such a handsome girl as you; you must wait till your father or your brother are here to go with you.' But the girl insisted, and at last her mother yielded and let her go. She had

not gone far when she met a tall, handsome young man, who spoke to her. He joined her, and his words were so sweet that she noticed nothing and knew not which way she went until at last she looked up and found herself in a strange place where she had never been before. In front of her was a great hole in the face of a rock. The young man told her that this was his home, and invited her to enter. She refused, but he urged until she said that if he would go first she would follow after. He entered, but when she looked after him she saw that he was changed to a fearful *wee-will-mecq*—a loathly worm. She shrieked and turned to run away, but at that instant a loud clap of thunder was heard, and she knew no more until she opened her eyes in a vast room, where sat an old man watching her. When he saw that she had awaked, he said, 'I am your grandfather Thunder, and I have saved you.' Leading her to the door, he showed her the *wee-will-mecq* dead as a log, and chopped into small bits like kindling wood. The old man had three sons, one named 'M'dessun.' He is the baby, and is very fierce and cruel. It is he who slays men and beasts and destroys property. The other two are kind and gentle; they cool the hot air, revive the parched fields and the crops, and destroy only that which is harmful to the earth. When you hear low, distant mutterings, that is the old man. He told the girl that as often as spring returned she must think of him, and show that she was grateful by giving him a little smoke. He then took leave of her and sent her home, where her family had mourned her as one dead. Since then no Indian has ever feared thunder." I said, "But how about the lightning?" "Oh," said the old woman, "lightning is grandfather's wife."

Later in the summer, at Jackson in the White Mountains, I met Louis Mitchell, for many years the Indian member of the Maine Legislature, a Passamaquoddy, and asked him about this story. He said it was perfectly true, although the custom was now falling into disuse; only the old people kept it up. The tobacco is cast upon the fire in a ring, and draws the electricity, which plays above it in a beautiful blue circle of flickering flames. He added that it is a well-known fact that no Indian and no Indian property were ever injured by lightning.

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The Council of the Royal Agricultural Society of England has instituted a fund to be contributed by all interested in agriculture, for preparing a testimonial to the invaluable services rendered to that art by Sir John Lawes and Dr. Gilbert. Subscriptions are to be limited to two guineas. The testimonial will take the form of a granite memorial, with a suitable inscription, to be erected at the head of the field where the experiments were made; and an address to Sir John Lawes and Dr. Gilbert, accompanied (if the funds permit) by a commemorative piece of plate.

# SCIENTIFIC COOKING.

## A PLEA FOR EDUCATION IN HOUSEHOLD AFFAIRS.

By Miss M. A. BOLAND,
INSTRUCTOR IN COOKING IN THE JOHNS HOPKINS TRAINING SCHOOL FOR NURSES.

THE general interpretation of the colloquial use of the word scientific as applied to cooking is that manner of making dishes which is carried out according to some exact method, which has been proved by experiment to be correct or satisfactory. This is well as far as it goes; but scientific cooking, in order to justly merit the name, should also include: 1. A knowledge of the chemical composition of food materials and food, that a woman may know when she is supplying her family with a diet composed of all those principles, in correct proportion, which are necessary to perfectly nourish the body, and also that she may appreciate that she is not always obliged to buy expensive materials in order to obtain that which is needful and wholesome. 2. A knowledge of the methods of preparing and preserving food, both cooked and uncooked, under such conditions of cleanliness that it shall be free from poisonous or noxious principles. 3. A knowledge of the laws of health, that it may be possible in some measure to determine what constituents and what eatables afford proper material for the maintenance of the body, and under what circumstances of occupation, exercise, and living in general they are most completely utilized.

Upon the subject of the composition of foods there is abundance of valuable literature in English from which much can be learned. Since the days of Baron von Liebig and Count Rumford, who may be said to be the promoters of the "cooking movement," a great deal of scientific investigation as to the chemical composition, nutritive value, and methods of cooking food has been done, and out of this study, in connection with medical research, has sprung the modern school of hygiene, as yet, however, in its infancy. In the works of Parkes, Pavy, Atwater, Foster, Smith, Blythe, and Hassal most valuable information on this subject may be found.

A well-grounded knowledge of the chemistry and physiology of foods is the foundation upon which all good work in cooking must be laid. Through it only can be known and appreciated the reasons which underlie the various processes of preparing food, which, once well understood, form the sure foundation upon which all conscientious and worthy effort should rest. Such knowledge embodies the principles of the subject, and without principles no work can possess lasting educational value.

The second suggestion, methods of preparing and preserving food so that it shall be free from poisonous and harmful substances, indicates the necessity for some knowledge of bacteriology. The various fermentative and putrefactive changes which take place in food substances are caused principally by the growth in them of microscopic forms of plant life known by the general name of micro-organisms.

When micro-organisms grow in masses, as may be seen in the green and yellow molds of bread and cake, they are plainly visible to the naked eye, but to distinguish individuals a microscope of high magnifying power is necessary. The common mildew, the decay of apples, melons, and other fruits, the rot of vegetables, and the decomposition of eggs and meat are due to the transforming power of these invisible agents. One of the most common and best known is yeast, which has been more studied and is probably better understood than any of the ferments. It is frequently mentioned to illustrate the transforming power of these infinitely tiny forms of life. A bit of yeast is like a little mass of seeds, each a single cell; these, when they are placed in a proper medium—in other words, find the surroundings of food, moisture, and warmth necessary for their life—multiply with extraordinary rapidity, using what they require of the food in which they find themselves, decomposing sugar and starch and establishing changes which result in carbonic acid and alcohol as the chief products. We take advantage of the production of carbonic acid by yeast to make our loaves of light and wholesome bread.

Micro-organisms are everywhere: they exist in the earth and the sea; in plants and animals; on the surface of our bodies and in the digestive canal; in cooked and uncooked food; in refuse, particularly animal waste; on our clothing, books, furniture, and in the dust of the atmosphere. Wherever they find suitable food, warmth, and moisture they increase with wonderful rapidity, and, if undisturbed would in time completely transform the object upon which they fall. However, by removing any one of the factors necessary to their growth, they cease to multiply, and under such conditions some species remain inert, some die.

Like other forms of life, micro-organisms by their growth give rise to various products which may be either harmless or harmful. Of the latter may be mentioned noxious gases which pollute the air and poisonous substances which render our food unwholesome. The souring of milk, and the putrefactive changes which, in the presence of heat, so rapidly set in in eggs, meat, oysters, lobsters, crabs, and other albumen-containing foods, are among the results of their transforming power. Perhaps the most important point for us to consider here is, that it is highly

probable that these substances just mentioned and others of similar nature often, when apparently good, contain poisonous matter in small quantities, which produces in human beings, when those foods are eaten, grave digestive disturbances. Should the eating of such food be continued for a length of time, or the amount of poisonous matter be large, serious results of illness, or even death, may follow. Instances are on record of fatal cases of poisoning caused by eating oysters too long out of the shell, lobsters not fresh, and other easily putrescible substances.

The object of the bacteriological study of food is not alone to prevent the use of actually poisonous materials, but also to prevent the use of those which are not absolutely good.

Perfect digestion, perfect assimilation, and as a consequence healthful blood can not result from the use of questionable food. If we attempt to consider what constitutes a healthy condition of body we find a very complex subject before us: constitutional peculiarities, manner of dress, surroundings, air, occupation, climate, etc., as well as food, all influence physical development. We find the answer involves too many points to be given simply and directly, but one very essential thing to do certainly lies in the direction of food. The nutritive material for replenishing the blood is made from the food we eat and the air we breathe; it, therefore, is entirely reasonable to claim that the condition of the air breathed and the preparation of the food eaten are of great importance.

Food should be wholesome in itself, prepared in exquisitely clean surroundings by neat hands, and cooked with intelligence. Food prepared by slovenly cooks in slovenly places not only is not æsthetically acceptable, but is neither palatable nor wholesome, and often contains ptomaines, toxines,* or other poisonous matter the results of changes of a dangerous character, or it may be contaminated with the bacteria of disease. When we know that micro-organisms are the primary cause of many kinds of fermentation, that all forms of food are excellent material for them upon which to thrive, that instances are on record in which poisons have been isolated from food which has caused sickness, it may be repeated that it is entirely possible that food kept in questionable places and prepared in an uncleanly manner does often contain that which is positively injurious to health.

It is evident that one of the first considerations of a thoughtful and intelligent housekeeper toward securing one condition at least of good health should be absolute cleanliness in all things—

* Ptomaines are certain crystallizable substances formed by the growth of bacteria. They are often but not always poisonous. Toxines are substances also produced by the growth of bacteria, but of a different nature from ptomaines; they are always poisonous.

that cleanliness which excludes as much as possible all kinds of extraneous ferments from food and its surroundings. We know that micro-organisms are the agents of fermentation; we know the factors necessary to their life, namely, food, warmth, and moisture; deprived of any one of these, their growth is stopped and they become inert, or die. To illustrate, a piece of meat deprived of moisture—that is, dried—is proof against the growth of organisms upon it so long as it remains dry, and it "keeps," as we say—that is, it does not decay; or, it may be hung in an ice-box or frozen as in winter—that is, deprived of warmth—with the same result. It, then, is a possibility to control the multiplication of these forms of life when we understand their modes of existence.

Scientific cooking should include not only the proper construction, so to speak, of eatables, but a knowledge of their constituents both inherent and extraneous, and some understanding of the physical life of human beings. Heretofore, cooking has been done for the most part upon what might be called "haphazard" lines, without any special degree of exactness and with but little actual information as to the nutritive value of the substances dealt with, or of the processes which would render them most palatable and digestible. This manner of conducting the cooking of a home gives mainly two results: (1) a great deal of wretched food, which directly or indirectly affects the health of the family, and (2) an enormous amount of unnecessary waste. The primary consideration is, of course, the one of health. When we recollect that hygienists and medical men hold the opinion that disease does not find lodgment in a sound body, that to be perfectly healthy means no sickness, except from accidents and natural causes, is it not enough to inspire all women to study and master the means which conduce to health and the laws which govern healthy conditions? This point may be illustrated by the fact that pneumonia does not attack healthy persons. Children, the old or enfeebled, and those who are debilitated, are its victims. Pneumonia is a bacterial disease, the germ of which is present in the mouths of about one fifth of all well persons. Exposure to cold, the prolonged use of poor food, or excessive fatigue, any of these may lower the tone of the system to such an extent that its cells and fluids, being out of their normal condition, can no longer resist or overpower the germ of the disease, which, finding lodgment in the tissues of the lungs, produces the malady known as pneumonia. It is on this point, that the cells and fluids of a *perfectly healthy* body have the power to protect the inner organs from the invasion of bacteria and bacterial products, that we base our strongest argument for more healthful ways of living.

The greatest necessity of life is air, which is supplied to us pure (outside of large cities), without the necessity of effort on

our part to procure it. We have only not to interfere with what Nature has given by inclosing it in rooms, or by allowing it to be contaminated with noxious gases or other impurities. The second greatest necessity of life is food, which includes water. Food is the raw material of the body from which it constructs its tissues and repairs them as they wear. It furnishes the elements from which are evolved the forces of the body, such as heat, muscular and nervous energy and other powers; of these, heat is the most important, it being ever required that the constant temperature which the body must always possess to be in a state of health may be maintained. Food also furnishes material for a supply which is stored away in the body for use in emergencies when from accident or other cause nutriment is cut off.

Food is to the body what fuel is to the fire. It and the oxygen of the air are the agents which maintain the life of the system. What can be more worthy our attention than so important a subject?

We all know that some kinds of food are more easily digested than others, and we also know that the same kind of food treated in cooking by different methods varies in digestibility, according to those methods. To illustrate, an egg cooked in such a way that its albumen is coagulated, but tender and jelly-like, not hardened, is a very easily digested food substance; while an egg cooked at a temperature so high that its albumen is rendered tough and tenacious is very difficult of digestion, and it is known that well persons have been made temporarily ill by eating eggs so cooked.

What is true of the egg simply illustrates what is true of nearly all food substances—that is, that the temperature at which they are cooked and the manner in which they treated, as to the time of exposure to heat and their combination with other things, makes all the difference in their digestibility and flavor. This constitutes our second argument for the study of cooking.

If only because we have at best but glimmerings of the complex, intricate, and mysterious processes of the life of the physical human body, should we strive to maintain it in most perfect condition, and endeavor in the clearest lights of modern science to make it indeed a temple for the indwelling of the mind.

It is thought by some students of the subject that crime is a disease; that had the men, who are to-day criminals, been reared under better conditions, of both nourishment for the body and influence for the mind, they might have been worthy, even noble citizens.

Missionaries, both at home and abroad, are beginning to realize that it is of little use to pray with a man until they have fed him. In fact, the first work of the missionary of to-day is to provide

the object of his thought with necessary food, clothing, and shelter, and care and relief in sickness. When these are adequate, and not before, is the exercise of the "so-called" religious influences of any avail. This, of course, is nothing more than practical common sense. A man reduced by lack of proper and sufficient nourishment, and surrounded by all the depressing influences of poverty, can not do wise thinking. There is not in his body the blood to send to the brain for use. Where there is no fuel there can be no fire.

It is safe to say, as a general rule, that when a man is well nourished his natural leaning is toward industry. He *must* have something to do. When a man is healthy and industrious he is a safe citizen. Health and industry united often point the way to ambition, and ambition directed in the right path may lead into vast regions of power and influence.*

No richer endowment can be bestowed upon one than a healthy and vigorous physical constitution. The possibility of starting man on the journey of life so equipped rests largely with women. The care of little children falls entirely to them during the time when they most need the greatest amount of wise and intelligent attention in order that they may be started in life with a sound body, which shall be the temple for the sound mind which is to be developed and cultivated later. Specialists of children's diseases claim that the manner in which a child is fed and cared for during the first five years of life determines what he shall be ever after.

I listened last winter to a series of lectures on insanity by a specialist of the subject. In speaking of the different forms of the disease, hallucination, melancholia, acute mania, etc., he said that those forms of disease almost always begin with the inability of the individual to digest food well. He does not eat well, does not sleep well, and after a time becomes what is called "nervous," which is usually nothing more than a malnourished condition of the nervous system; then he drifts into melancholia and finally insanity.

The treatment by Weir Mitchell the noted specialist of such diseases, is what might vulgarly but graphically be called *stuffing*. His patients are put to bed under the pleasantest and most comfortable conditions of absolute rest and freedom from responsibility, and then they are fed with as much nutritious and wholesome food as they can be made to eat. The results of this treatment have been most gratifying.

What woman with the belief that it was within the bounds of

* By ambition here is not meant the worldly ambition of amassing a fortune, but the noble ambition of doing some worthy and useful work in the world.

the probable for her to save a member of her family from even the possibility of any form of insanity, would not devote months, even years, to the study of those principles and conditions of life by which robust health may be maintained? It should not be understood that I would imply that bad food is the cause of insanity, but it can be said that we have sufficient proof to lead us to believe that many cases of insanity might have been prevented had the individuals been properly nourished; of course, it must be borne in mind that this means not only the eating of proper food, but its proper and normal assimilation in the body.

It is woman's province to control and manage the household. Whether she does it wisely or unwisely rests with herself. No one else can absolutely fill her place. She should, therefore, study the phases of home affairs with the same application and assiduity that she would give to a difficult problem, which may require weeks, months, even years, to work out, but which in the end must be solved.

A man enters the arena of business with the full purpose of being master of whatever he undertakes. He knows that he must succeed. Reputation, social position, comfort, progress, the happiness of his family, even life itself, may depend upon his efforts. If woman would feel the same responsibility in regard to her home—that she must succeed in making it a peaceable, health-giving, moral-giving abode, and would never waver until she had accomplished it—we should reach a state of advancement in the understanding of life which, except among some in the cultured classes, is not general to-day. I do not maintain that the study of household science will enable woman to do *all* this, but such study will help greatly, perhaps more than anything else, toward that end. It is one of the important factors in that result, and if for no other reason than that it will make life for women in the performance of their household duties pleasanter, more satisfactory, sweeter, easier, it is more than worth trying. To work in the dark is ever perplexing; to work in the light of intelligent understanding is one form of happiness.

The study of household science, taken in its full and broad sense, leads into boundless fields of research. The phenomenon of heat, the currents of the air, the life and chemical nature of the products of the earth, the mysterious and complex processes of nutrition, fall almost without mention into such work; the sciences of chemistry, physiology, and bacteriology are its foundation stones; in fact, whatever bears upon the physical life of man is included in it.

Now let us consider by what means the women of to-day and of the future may obtain a scientific education in household af-

fairs. I would suggest, first, schools of domestic science and hygiene in which girls shall be taught the subject on the same educational basis and along the same liberal lines that they are taught other things.

A beginning in this line of work (though not in kind) has been in progress for several years in some cities, notable among them the city of Boston. The subject, however, has been taken up in an elementary way and in one of its branches only—that is, cooking. Cooking was introduced to that city by a woman of wealth and benevolence, through whose influence several school-kitchens were opened and maintained at private expense (borne chiefly by her) for a year, to demonstrate to the school authorities and the public what could be done in that line of education. At the end of the time, in the autumn of 1885, the school board decided to adopt the cooking schools as a part of the public educational system, and now there are eleven such schools in that city. Cooking is also taught at public expense in New York, Milwaukee, Des Moines, Washington, Philadelphia, Los Angeles, and in many smaller cities throughout the land. These are for the most part schools in which the making only of dishes is taught. They should be extended to include the study of the sources, composition, and nutritive value of food materials, heat, ventilation, cleaning, serving, and the laws which govern health and disease.

The second method which I would suggest for the extension of our subject is by means of private schools, lectures, and demonstration lessons, by which any person may gain the information which has been suggested should be taught in the public schools. Third, by study and experiment at home, where there is always opportunity for such work. There, by the aid of books and investigation, an educated woman may work out and perfect plans and methods for the management of her home.

Educational and industrial unions, where the products of the culinary skill of women are offered for sale; diet-kitchens, in which wholesome dishes are sold at small price; cooking schools like those in the city of Boston, in which the girls in the public schools are taught methods of cooking; private schools, such as the Boston Cooking School and the New York Cooking School, to which one may go and take one or many lessons in invalid, family, or fancy cooking, and where demonstration lessons are given throughout the year; experimental stations, such as the New England Kitchen in Boston, in which chemical and bacteriological investigations are made upon both cooked and uncooked food, under the supervision of an expert chemist; the Storrs experimental station, in Middletown, Conn., which is a purely scientific school for the investigation of food products and the study of dietaries; Pratt Institute, in Brooklyn, in which an ad-

mirable course in domestic science is offered to those intending to teach—all these in their different lines are excellent, and all tend toward the same thing, namely, better ways of living.

Mrs. Ellen H. Richards, of the Massachusetts Institute of Technology, is the inspirer of the New England Kitchen, and W. O. Atwater, of the National Agricultural Department at Washington, D. C., is the director of the Storrs experimental station. A series of articles written by him and published in the Century Magazine, 1887–'88, are among some of the most valuable contributions (in English) on the subject of food and dietaries that we possess.

Society may be roughly separated into three divisions. In the first are the wealthy and the well-to-do; the second comprises the great and powerful middle classes; and the third is made up of the poor. In the first, the household affairs, for the most part are managed by servants; in the second, by the wives and daughters of the family; and in the third we may say they are not managed at all. If no other than the latter class—the poor—were to be benefited, my plea for the cooking school would have more than ample excuse for being written. Among them, alas! who can least afford it, do we find the greatest amount of waste in cooking, much ignorance in the caring for and buying of food, the most unsanitary surroundings as to pure air and cleanliness, and the greatest amount of sickness resulting from bad living.

The following item alone gives one a glimpse of the misery among the poor: In the city of Baltimore, during the year 1891, in a single hospital thirty-three thousand patients were treated in its free dispensary, and in the same city for the same year $1,250,000 spent in public charity through the various charitable organizations and societies for the relief of the poor.

When we bear in mind that statistics of hygiene show that at least seven tenths of all forms of illness and disease originate directly or indirectly from bad food, bad air, and unsanitary surroundings, and unhygienic ways of living in general, can any one fail to see the infinite amount of good that it is possible to do by establishing schools in which the people may be taught the principles and practice hand in hand of household science?

It is to the public school, not simply a school of methods, but of principles as well, that we must look for the greatest and most lasting good in this direction. There the children of all classes may gain correct instruction in hygienic living; there the subject can be brought to their notice and presented in its true educational light; and there, and there only, can the great middle and lower classes be reached. Private schools may do locally much good, but their influence is not widespread unless they are great. It is only through the public school that this necessary and most

valuable information can be diffused throughout the land; and not the least of the benefit which will come from such work will be the moral effect of intelligent study and the pleasure and satisfaction of working out understandingly some of the many perplexing problems of every-day living.

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# PREHISTORIC JASPER MINES IN THE LEHIGH HILLS.

By H. C. MERCER.

BEGINNING at Durham, Bucks County, Pennsylvania, and following the trend of the Lehigh hills toward the Schuylkill near Reading, and generally in close connection with veins of hematite, occurs a series of outcrops of the hard homogeneous rock known as jasper. This many-colored stone with its smooth, conchoidal fracture stood somewhat in the same relation to the North American Indian that iron stands to us. With it he fashioned his best spears, perforators, knives, arrowheads, and scrapers. No less diligently did he seek for it than does the man of the nineteenth century search for that great lever of his power and progress, iron; and no less persistently did he quarry it, shape it to his needs, and transport it to great distances.

So Indians in the West had been known to quarry jasper at the now famous "Flint Ridge," in Ohio; novaculite at their great quarries in Garland County, Arkansas; jasper, or hornstone, again in the Indian Territory; quartzite at Piney Branch, in the District of Columbia; obsidian, or volcanic glass, in the Yellowstone Park and Mexico, and other workable stones at other places. But whence the jasper supply came from east of the Alleghanies has long remained a mystery. Even the State geological surveys did not seem to recognize the existence of jasper in the eastern Lehigh hills; so that the recent series of discoveries, by expeditions in the interest of the University of Pennsylvania, have thrown an unexpected light upon the story of ancient man in the Delaware Valley.

The thanks of the university are due to Mr. Charles Laubach, of Durham, who first introduced the explorers, in 1891, to the aboriginal jasper quarry on Rattlesnake Hill, at Durham, Bucks County, Pennsylvania, and to Mr. A. F. Berlin, of Allentown, who, by a series of valuable clews, greatly furthered the work of subsequent research.

How did the Indian, armed only with tools of wood, bone, stone, or beaten native copper, make the excavations, sometimes quite twenty feet in depth and one hundred in diameter? Did he use pickaxes made of deer antlers, as did the ancient flint-workers

of "Grimes' Graves" near Brandon, in England? Did he encounter the rock in solid ledges as in Arkansas, or in loose nodules? Did he reduce it by fire, splinter it with hafted stone hammers, such as are found at the prehistoric copper mines on Isle Royale, in Lake Superior, or by battering bowlder against bowlder? Did he finally chip the material into arrowheads at the quarry, or carry away lumps of the stone to be worked up elsewhere?

These and many other questions we asked ourselves on a first glance at the bramble-grown pits and refuse heaps on the lonely hilltop at Durham. And after a careful study of the place, several

FIG. 1 ($\frac{1}{3}$).—*a*, CAST OF POINTED WOODEN DIGGING IMPLEMENT; *b*, CAST OF LOG SHARPENED BY STONE TOOLS. Jasper Mines, Macungie, Pa.

expeditions sent out on this and the preceding summer, resulted in the discovery of eight new quarries lying in a continuous line from the Delaware almost to the Schuylkill.*

All, though varying greatly in size and quality of material, tell the same story.

In some, the excavations, filled with forest mold and overgrown with trees, would escape the attention of the casual rambler until the piles of flakes, yellow and rose-tinted, easily displayed by scraping away the leaves that concealed them, revealed the handiwork of the ancient quarryman.

But at others, as at Macungie and Vera Cruz, the passer-by would halt in amazement. The appearance is too unusual, the work too vast—one hundred to one hundred and fifty pits, some of them fifteen and twenty feet deep and one hundred to one hundred and fifty feet in diameter, is no every-day sight. Again, the tinted flakes and refuse heaps tell the tale, and the neighboring

* At Coopersburg, Limeport, Saucon Creek, Vera Cruz, and Macungie, in Lehigh County and at Long Swamp, Bowers, and Leimbach's Mills, in Berks.

wheat field glistens with fragments, yellow, blue, purple, red, lavender, and veined in many hues. The forest, too, has set its stamp of age upon the scene, and an old chestnut stump growing on the side of one of the excavations, upon which we counted one hundred and ninety-five rings, proves that the workman must have abandoned his shaft to the growth of underbrush about the time (1682) that William Penn bought his first tract of land from Indians on the Delaware.

And then, as, standing before the ancient works of the mound-builders at Grave Creek, Marietta, and Newark, a strange feeling

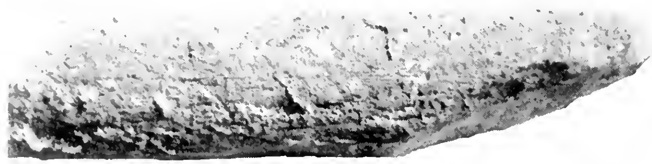

Fig. 2.—Part of $a$, Fig. 1, enlarged, showing Stone Tool Marks.

born of awe steals over us, so here by degrees the scene assumes its true hue of wonder. We have had a glance beyond the boundary lines of history into the unillumined darkness of this continent's past, and for a moment heard the echoes of that vast forest mysterious with the fate of lost races that for ages darkened the New World before the coming of Columbus and De Soto.

It was important to learn that at Vera Cruz and Macungie, farmers, believing the excavations to have been the work of early Spanish gold-seekers, had dug deep trenches across several of them to find that some, judging from traces of disturbance in the soil, had reached a depth of forty feet; that one was square rather than round; that in those examined there had been no tunneling done, the lateral enlargements having been made from the surface downward.

In the bottom of two pits it was alleged that charcoal was found, and in one case, deep buried in clay at the very bottom, the remains of a textile fabric, and several decayed billets of wood about two feet and a half in length, with points at one end, blackened by charring. In all instances pure nodules of jasper were to a great extent wanting in the pits, but were found imbedded in the soil as soon as the unworked edges of the excavations were reached.

Our own preliminary work proved that in one of the diggings at least the miners had not attacked a solid vein of jasper, but, finding it in bowlders on the surface, had removed these, to work out others imbedded beneath them; and when in the undisturbed bottom of our shaft, at a depth of nineteen feet, we dug out a small, yellow-coated nodule, we were but continuing the long-suspended process of the quarryman, who, prying out the masses one

by one, must have scraped away the surrounding clay till the pits were made.

That fire had been extensively used on the surface there was no question, whether in the clearing away of underbrush for mining at successive times, or, as seemed probable in one case, in reducing the large fragments, and coloring yellow jasper red.

But far more interesting was it to find fifteen feet down in our shaft an oven designedly made of large blocks of coarse jasper, in the hollow of which rested a mass of charcoal and ashes. To be satisfied that the bowlders had been thus cracked and splintered by heat, it was but necessary to notice their reddened sides and gather up the fire-fractured fragments of all sizes in their cavities.

Several holes in the clay near the bottom were no more nor less than the perfect molds left by objects of wood long since rotted to nothingness, and these enabled us by pouring in plaster of Paris to recover the forms of a piece of sapling about two feet in length, and the fragment of a larger tree, both pointed at one end, and plainly showing the marks of the stone tools that had sharpened them. (See Figs. 1, 2, and 3.)

That one at least of these billets (Fig. 1, *a*) was intended for use in quarrying there could be no doubt; still less that a large disk

FIG. 3.—PART OF *b*, FIG. 1, ENLARGED, SHOWING STONE TOOL MARKS.

of bluish limestone, chipped into the form of a heavy hoe, and well worn on its edges, if not a smaller fragment of quartzite, had been used as rough digging tools. (See Fig. 4, *a*, *b*.)

But as the pickaxe struck fire on the stones and glanced often impotently from the compact clay, our wonder at the ancient toiler's perseverance, challenged by this glimpse of his tools, increased. Still, even granting all the pits a depth far beyond their appearance, we little suspected the immense amount of work done, until the arrangement of layers in our shaft, the scattered bits of charcoal, the belts of stone-chippers' refuse, and the five distinct fire

sites there encountered, proved beyond a doubt that our excavation had not caved in, but had been deliberately filled up by the prehistoric quarryman, who, realizing the economy of keeping the unworked ground free from excessive earth heaps, had evidently carried (in baskets or skins) the newly dug soil from the fresh diggings to the exhausted pits.

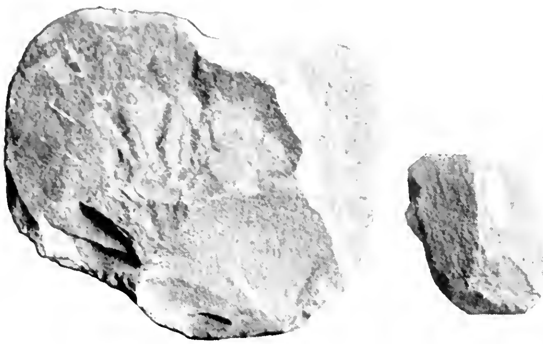

Fig. 4 ($\frac{2}{11}$).—Stone Digging Tools.

Turning to the surface refuse heaps, and from the artificially flaked fragments exhibiting no succinct design that strew the ground everywhere, we find (*a*) a series of well-battered quartzite hammer stones, not pitted on their sides, and varying from an inch and a quarter to five and six inches in diameter; (*b*) a mass of very interesting, artificially shaped blocks, that all tend in the direction of an ideal leaf-shaped form, and which in their various stages resemble the famous implements or objects from Trenton and Ohio known as "turtlebacks" and "palæoliths."

Our attention is further called to the facts that there are few, very few, arrowheads at these spots, and as yet no traces of pottery, no banner stones, net sinkers, gorgets, or grooved axes; that, in a word, these remote places, buried in the forest inconveniently far from water and arable land, were not fit for village sites. They were quarries—nothing more, nothing less—whither the jasper-using modern Indian, as known to Captain John Smith, Campanius, and Kalm, resorted, must have resorted, to quarry his material, knock it into portable shape, and carry it away to the distant village.

By a few blows of the pebble hammer the weathered surface of the nodule (Fig. 7) is chipped away and the thick block takes a pointed shape. A series of further blows, more careful and probably struck with the small hammers, produce a serrated cutting edge around the whole fragment, which now, well marked with the chipping that unmistakably proclaims the handiwork of man (Fig. 5), though still rude, clumsy, and an inch or two thick in the middle, has become the typical "turtleback" of Trenton. It may be that a final series of flakings, whether due still to the hammer or to pressure, results in a quite symmetrical blade, lightened to the desired weight and ready for transport (Fig. 6).

There the quarryman's work seems to have stopped, if it always went so far, and the hoard of blank blades ready to be finished or specialized by some local arrowhead maker into perforators, arrowheads, spears, or knives, as the case may be, is carried away. When for a time its owner is compelled to part company with it, he buries it in the ground for safe keeping or to render the material softer for future work,* and there for a dozen rea-

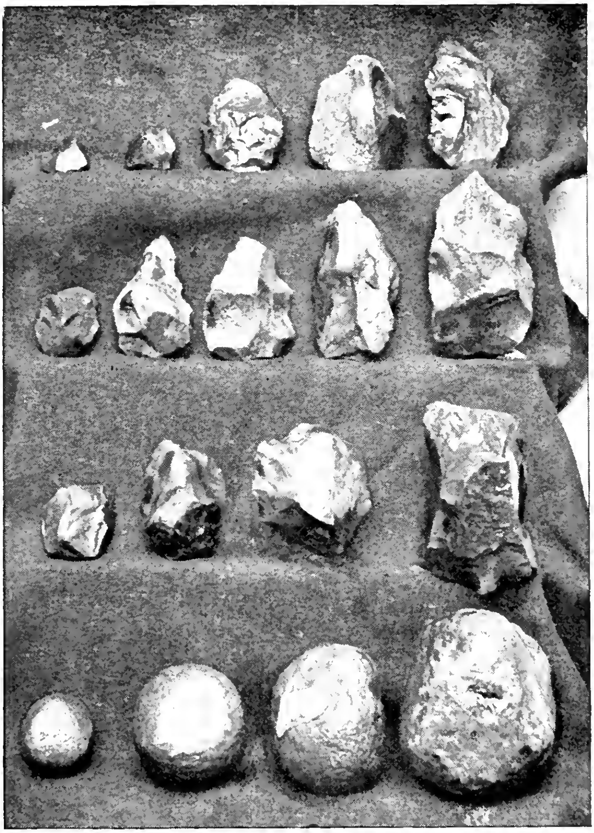

Fig. 5 (about $\frac{1}{4}$).—Hammer Stones and Blocked-out Blades. Jasper Mines, Macungie, Pa.

sons it may remain for long years, to be discovered at last by a surprised plowman.

Such a *cache* of hitherto "inexplicable" leaf-shape implements, consisting of one hundred and sixteen yellowish argillite blades,

* But the flint "knappers" at Mr. Robert Snares's gun-flint works at Brandon, Suffolk, England, told me that they always dried the nodules by the fire or in the wind, as the hammers would not "take hold" of flint wet from the mines. Argillite, on the other hand, so say the quarry men at Point Pleasant on the Delaware, flakes better when wet, as, in my experience at Macungie, jasper does also.

we found, in 1891, on Ridges Island, on the Delaware; another of one hundred and seven of blue argillite was obtained for us by Mr. Doan, at Bridge Valley, Bucks County, Pennsylvania, last May, and another of nine blanks of chert was found by us in June of last year, on an island in the Susquehanna; while on the other hand that the material was sometimes carried away from the mines in the rough, was proved to us by the discovery of a large nodule partly chipped at the village site of Upper Blacks' Eddy, on the Delaware, ten miles from Durham, and another smaller mass on the river shore at Fry's Run.

The story of the Lehigh jasper quarries thus glanced at, but soon to be fully and carefully studied, is thus far a corroboration in main of the recent researches of Mr. W. H. Holmes at Piney

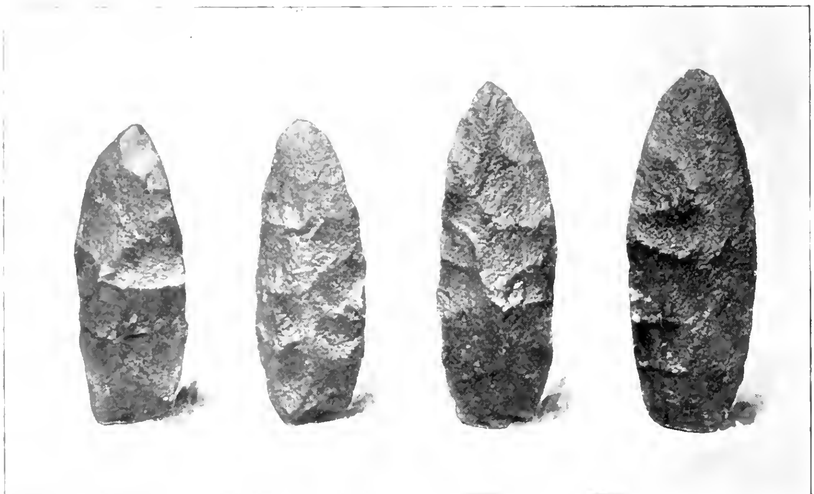

Fig. 6 (½).—Cache Blades. Bridge Valley, Pa.

Branch, in the Indian Territory, and in Garland County, Arkansas. Is it the story of all jasper quarries in the United States? Is it the story as well of the argillite sandstone and quartzite quarry sites and the obsidian workings not yet discovered and studied? In a word, are we right in supposing that this process of passing from the shapeless block (Fig. 7) to the "turtleback," and from the "turtleback" to the thin, leaf-shaped blank, and thence to the spear or finished implement, represents the necessary steps through which all peoples in an age of stone have passed in the fashioning of their rock-hewn tools?

Thirty years ago Indians were chipping arrowheads of obsidian and hornstone on the shores of the Sacramento. Many of them still live in the United States and Canada who can doubtless explain the whole matter. Sometimes their opinion has been asked

and their work described, but the accounts of their white questioners have been vague, contradictory, and unsystematic. None of them explain the quarry, the turtleback, or the *cache* implement.

Caleb Lyon, who saw about 1860 a Shasta Indian arrowhead maker at work, refers only to a slab of obsidian one fourth of an inch thick, split from a pebble and flaked by blows. T. R. Peale speaks only of hammering a mass of jasper, agate, or chert with a round-faced stone and finishing up the edges with a notched bone, as a glazier chips glass. Schoolcraft saw an anvil of wood or some hard substance placed on the thigh, upon which a piece of jasper was held at rest to be hammered by something undescribed. Captain John Smith tells how the Indian "quickly maketh an arrowhead of splints of stone in the form of a heart, with a little bone, which he ever weareth at his bracept." Torquemada and Hernandez briefly describe seeing Mexicans sending off long flakes of obsidian, with which certain Spaniards had their beards shaved, by pressing a wooden punch on a nucleus of obsidian held between the feet.

Fig. 7 (about ½).—Natural Nodule of Jasper Flaked on One Side. Long Swamp, Lehigh, Pa

Admiral Sir E. Belcher (about 1858–'60) saw Eskimos, California Indians, and Sandwich Islanders fracturing chert blocks with slight taps of nephrite hammers, and then flaking the splinters wedged in a spoon-shaped cavity in a log, with a point of deer horn.* And so on. Lieutenant E. J. Beckwith and Catlin tell of flaking small pieces and thin slabs of quartz and obsidian, by direct pressure and indirect pounding upon a bone punch; and certain white men have recently made arrowheads out of curiosity or to palm them off upon collectors; but neither the conflicting accounts nor the amateur experiments explain the leaf-shaped hoards (Fig. 6), or the inchoate forms (Fig. 5) that litter the quarry refuse. Evidently some of the chief underlying features of the first and greatest of man's primeval arts have not been grasped. The living Indians who remember the process must be questioned again.

* See for these narratives, except Beckwith (Pacific Railroad Survey, vol. ii, p. 43), E. T. Stevens's Flint Chips, p. 57.

Turning back to the quarries and refuse heaps, and passing by the many problems of deep archæological interest that they suggest, suffice it here to say that for one fact already mentioned they claim attention among the foremost fields of American research.

Here, at a distance of from forty to fifty miles from Trenton, are scores of jasper specimens closely resembling the forms of argillite found there buried fifteen and twenty feet in the glacial gravels: imitations, so to speak, of the so-called "palæolith," or

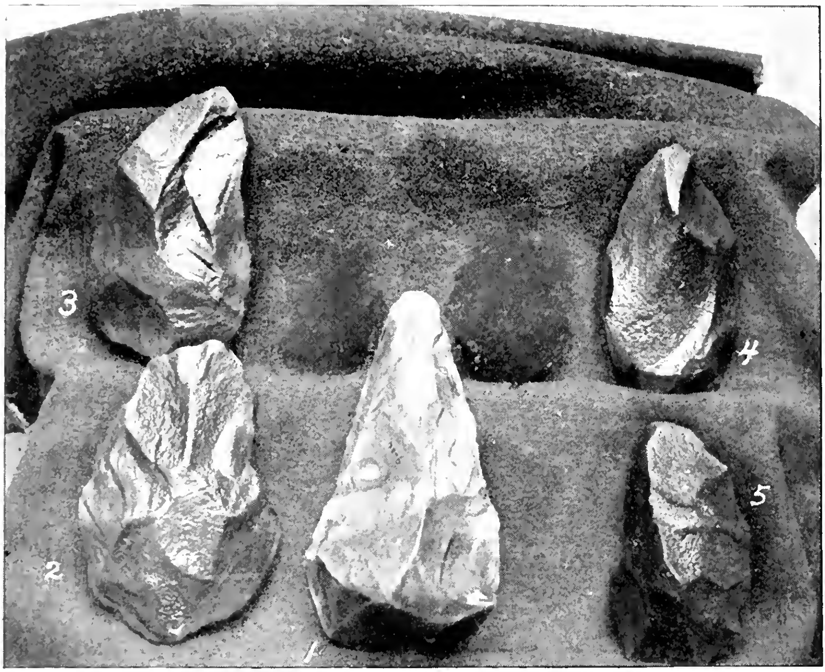


Fig. 8 (⅕).—1, Flint Palæolith from St. Acheul, France; 2, 3, 4, 5, Turtlebacks of Argillite, Delaware Valley. (Found on the surface.)

implement of the savage ice man, who, seven thousand years ago, chipped river pebbles on the freshet-swept banks of the Delaware.

We have been told that this object from Trenton, this "palæolith," is a finished implement, a type of an epoch; that the savage who fashioned it was little better than an ape in culture, ignorant even of the use of the bow, and a slayer of his prey with clubs and stones. And science has willingly stolen into the by-paths of wonder and speculation to suggest his origin and fate. Akin it was said to the river-drift man of Europe, he crossed the North Atlantic on an isthmus that in preglacial times stretched from Britain to Greenland to dwell on the cold shores of the Delaware when the great glacier stretched its coping of ice from the Hud-

son's mouth to Oregon, and while the Niagara River yet tumbled its cataract into Lake Ontario at the site of Lewiston.

At first, as we take up these shapes from the quarry (Fig. 5), rude as the rudest from Trenton, yet geologically an affair of yesterday, doubts assail us on all sides. What if the Trenton specimens, after all, are modern too? Did they slip downward into the drift through the fissures of earthquakes, root-holes, the cavities left by upheaved trees, or by the deceptive readjustments of strata that sometimes puzzle geologists on the face of bluffs and banks? The supposed lapse of ages between them and the Trenton implements seems to fade away. We are almost startled. The doors of archæology's wonder chamber have been thrown open, its treasures displaced, and the strange form of palæolithic man, slipping out of our grasp, seems ready to vanish into the limbo of chimeras.

But pondering long over the work of the quarries, and comparing it diligently with the workshop refuse on the pebbly shores of the Delaware and Susquehanna (see Fig. 8), where argillite "turtlebacks" (Nos. 2, 3, 4, and 5) are often found at Indian village sites, ideas suggest themselves that may well efface all bias from our minds, and effectually disincline us for a premature conclusion.

What if these modern stones (Fig. 5) do resemble "palæoliths?" What if the Trenton forms like these were only steps in the process of fashioning blades not yet found? What if the Trenton "palæolith" were not a finished implement, as has been declared?

What if glacial man, in a word, was not a "palæolithic" man at all, ignorant of the art of stone-polishing, but the equal in cultivation of even the modern Indian?

Is he any the less old? Is he any the less interesting because we can no longer pick up a stone, like the American specimens in Fig. 8, on the surface and say, "This is a palæolith"? Is he any the less a glacial inhabitant because modern Indians have duplicated one of his stone relics, and we are obliged to reform our American definition of the word "palæolithic"? *

As we tread the rough, hilly roads and clamber the rocky slopes that often lead to the jasper mines, nothing strikes us more forcibly than that man must have been a long time a dweller in the Delaware Valley before he discovered them, and that his first

* We speak in America of "palæoliths" and "true palæolithic implements," as if the terms could mean nothing but the rude forms here discussed. But the cave men of France, who, it is said, did not polish stone, though they polished bone and produced realistic animal carvings superior to anything done in the bronze age, were no less palæolithic than the drift savage who made Fig. 8, No. 1. And if Sir John Lubbock's definition means anything, the delicate blades of chipped flint from Solutré and the caves of Laugerie Haute, Gorge d'Enfer, Grotte de l'Eglise, etc., skillfully worked as the beautiful obsidian knives of California, Tennessee, and Mexico, are true "palæoliths." (See De Mortillet, Musée Prehistorique, classification.)

stone implements would have been fashioned, not from jasper, but from the material first at hand.

The shores of the large rivers, where no one denies that he made his earliest habitation, are strewn with pebbles of convenient size and conchoidal fracture, and from these (who can doubt it?) he made his first tools, whether already elsewhere taught the value of jasper or not.

From Belvidere to Chester, from Beach Haven to Havre de Grace, the river beaches may be looked upon as one great pre-

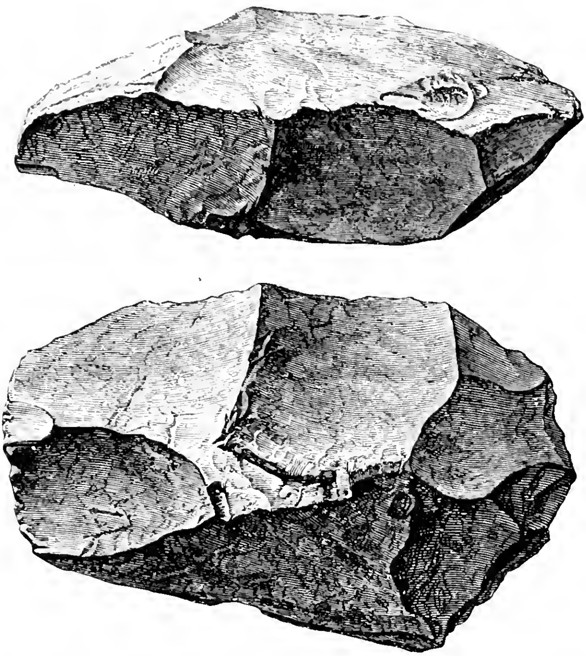

Fig. 9 ($\frac{1}{1}$).—Two Views of a Specimen from the Trenton Gravels. (See Abbott's Primitive Industry, page 500.)

historic quarry littered with the chips, the hammer stones, and the refuse implements of vanished peoples; and while the remote jasper quarries were disassociated of necessity with abundant traces of village life, here were quarry and village sites combined, where the relics of the stone-chipper must needs lie within a few feet or yards of those of the potter, the fisherman, and the hunter. It is here rather than upon the hilltops of Durham and Macungie that archæology may look for man's earlier and intermediate handiwork in stone, the telltale sites whose relics more or less deeply buried shall carry us back to the morning of his first coming.

Meanwhile, with eyes wider open, we are ready for another ransacking of the gravel pits of Trenton and Madisonville. More

sharply than ever shall we look for a bit of pottery seven thousand years old, an arrowhead or grooved stone axe, and without unjust doubt ask the questions: Have we been deceived? Have the classic stones slipped down into the gravel through Nature's channels? Has a landslide tricked us with its mastodon's tooth and human skull? And then, where are the hammer stones, and the chips, and the signs of use on the "turtlebacks," and the thinned-down blades, which shall prove for what purpose glacial man might have made these leaf-shaped forms—whether like the modern Indian he treated them only as blocked-out types of more specialized tools, or whether, still a child in the stone-chipper's art, he halted at the second step in the process, and, unskilled to go further, used the now famous "turtleback" as a finished implement sufficient for his primitive needs?

It is well that we have this new light from the jasper quarries on the great art of arts that most concerned man's life and happiness in the untold ages of his childhood. One source of error and confusion has been cleared away from the subject, and we fully realize that what shall in future determine the age and nature of these stones is not their "type" or their form, or their resemblance to European specimens, but their geological position.

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## ORIGIN OF LITERARY FORMS.

By M. CHARLES LETOURNEAU.

WHAT in current language we call literature, the literary æsthetics of civilized peoples, poetry intelligently composed and revised according to complicated metrical laws—written works, made to be read, not sung, and addressed to a cultivated public—only represent the last term of literary evolution. Primitive literature is very different, and is everywhere the same. Its origin is extremely distant, and it is probable that it even preceded, in our most ancient ancestors, the invention of articulate language—that great step which sealed the transformation of the anthropopithecus into man. That precious acquisition, however, was not miraculous nor instantaneous. The first speech was certainly very rudimentary; and before conquering it, the anthropoids from which man slowly issued possessed, like all other animals, a vocal language constituted solely of modulated cries resulting from simple reflex actions, automatic, and corresponding to the necessities, the desires, and the feelings of beings of little intelligence. In the brain of the anthropopithecus the passage from the cry to speech marked the beginning of a complete psychical revolution. It must have been effected with great slowness, and

supposes a life in society of a cyclic duration, for the isolated infant still does not speak. The first words were probably cried or sung. Our very young children still sing before speaking, and even begin with singing their first articulated sounds; and not till they are three or four years old is their speaking voice clearly distinguished from their singing voice.

As in the human species the singing voice is much the most ancient, it has also left very deep impressions on our mentality. Certain cries, certain *timbres* or modulations of the voice, will to-day awaken in the most civilized man latent and profound impressions, and excite emotions that seize the hearer's very heart. From this psychic basis bequeathed to us by our ancestors, from this mental paleontology, are derived our taste for music and its emotional power. Those cries, those passionate accents, have more power over us than the most moving discourse, because they have been, through the long chain of ancestral generations, the expression of intense feeling of which we have not ceased to be susceptible. At the bottom, traced back to its origin, music is nothing more than the æsthetic imitation of particularly expressive vocal emissions; consequently its psychical roots go down very deep into the past, to the time when man began to be differentiated from the animal. It is, therefore, very much of course that in all races song should constitute one of the principal elements of primitive æsthetics. This is a fact that we have been able to verify everywhere, even among the most inferior types of men, as among the Pécherais of Terra del Fuego, whose song constitutes in itself alone all their æsthetic expression. Yet this is a rare, an exceptional fact; for usually, in primitive æsthetics, song is closely associated with gestures and mimicry, which, from the origin of our species, were probably secondary to the voice not yet spoken, illustrating the significance of the cry; for vocal sounds and gestures are equally reflexive acts, and the voice is only the result of muscular contractions, of laryngeal gestures.

The more rudimentary articulated language is, the more necessary to it is the aid of mimicry. Our children gesticulate long before they have learned how to talk, and they continue to do so long afterward; and we first succeed in communicating with them by means of gestures. Even the adult man, of the highest civilization, rarely confines himself to articulate language alone. Nearly always gestures are added automatically to the words, to sustain them, as comment, or to moderate or intensify the expression. The refined rhetoric of artists in speech makes great use of mimicry, and the ancient rhetors of Rome esteemed action very highly. The literary æsthetics of all primitive peoples, therefore, comprised at once song, speech, and gestures. Thus we have seen the men of all countries and all races beginning in literary

æsthetics by blending into an indissoluble trinity mimicry, music, and poetry, or, in short, song and the scenic dance. In fact, as we have often shown, articulate speech begins by being the least important member of that æsthetic trinity; a simple accessory of the song—that is, of rhythmical, cadenced modulations—it defines their sense, but can not separate itself from them, and often gives place to simple modulated cries, to interjections, and to onomatopœias. In fact, with different primitive peoples, we have found species of romances without words, traces of an ancient interjectional poetry which probably preceded spoken poetry. The interjectional refrains, frequent among primitive men and in our popular songs, are evidently survivals of this same æsthetics.

We have seen that in all the earth the object sought by the primitive peoples in their dances and ballets is less the pleasure of rhythmical motion, to which they are, however, very sensitive, than significant, scenic mimicry, reproducing acts and adventures fitted to excite a lively interest in the little social community of which they form a part. What they want most of all is an expressive spectacle, giving the idea of a hunt, a battle, a cannibal feast, and their incidents; but such a dramatic ballet supposes the existence of a close association, of that communal clan which we meet in the origin of all societies, and which has everywhere modeled primitive æsthetics. These choral dances, these opera-ballets of savages, constitute in all races the collective rejoicings or ceremonials of the clans. We have found them among the Tasmanians, the Papuans, the Kafirs, the Polynesians, the American Indians, the Hebrews, the Greeks, and other nations. These scenic diversions always represent events of capital interest for the little social unity; and the nature of the events differs according to the degree of civilization. With the American Indians, they refer to the hunt or to war; with the Chinese, to different incidents in rural life, labor, the harvest, etc.

These beginnings of literary æsthetics explain to us why, among civilized peoples, music excites many persons to movement, to action; it is because the two were long associated in the ancient clans. But it addresses itself to very intelligent persons, with whom the necessity for muscular activity yields to that for mental activity, to the feelings, to the thought, when music, instead of exciting the muscular system, awakens the heart or stimulates the mind. It, for example, inspires in a Stendhal the desire to coöperate in the enfranchisement of Greece; in an Alfieri, plans for tragedy; and in a John Stuart Mill, philosophical speculations. In all these cases, in short, music plays the part of an excitant that determines different reactions according to the various modes of the mental organization.

The taste for measured, rhythmical musical sounds is, as we

have seen, both primitive and universal. From this very taste has sprung the invention of meter, or the art of closely marrying the words to the melody, and consequently of counting the words and even the syllables of the words when they have more than one, of regarding their accentuation in chanted poetry, the only form that originally existed. In the primitive choirs the air was the most important element; the words were probably regulated by it. They were fitted at first with much difficulty and very imperfectly, by recourse to exclamations, to interjections void of sense, in order to fill blanks and create rhymes. Sometimes among very inferior races the rhyme and the pleasure of pronouncing it were obtained by simply repeating a word or a short phrase, as the Fuegian and the Australian do. Very commonly the essential element of the meter is the more or less imperfect rhyme, the rhyme by assonance. The verse without rhyme of some civilized peoples, like the Greeks and Latins, which depends chiefly on the tonic accent of the words, supposes a language developed and highly refined; but at bottom it also rests on combinations of assonances. The primitive songs never being written, very imperfect rhymes sufficed for them. It is only among civilized peoples that meter becomes learned and complex, when poetry is almost entirely in the hands of professionals.

Usually when meter becomes more rigorous the length of the verse increases. Taken by themselves long verses indicate a refined civilization and a perfected literary æsthetics. The primitive verses are nearly always short, partly because they express short ideas, and partly because the desire for the repetition of agreeable sounds and the taste for rhymes or what represents them are more lively as man is less developed.

In China, where metrical evolution can be followed step by step, the verse in use has passed very slowly from four feet to seven feet. Arabian verse has been expanded in another way—by combining two short verses in one; and in a like way in the French Alexandrines the hemistich is a survival of a former epoch when the verse was very short. In India, Sanskrit verse, uneven but generally short in the Rig Veda, has been lengthened in the epics to fifteen syllables, with a hemistich.

Poetic diction, with its music and its meter, enjoys everywhere a peculiar prestige. It gives play to æsthetic impressionability, and has a dignity unknown to common language. On the other hand, verse easily engraves itself in the memory, and the ideas which it expresses form a sort of mental fund to which a great importance is attached, for the choral poetry of the primitive peoples sang only of subjects especially interesting to the community. Hence it comes to pass in many countries that even in the heart of old civilizations, far detached from their origin, the

poetic form suffices to give any idea a great authority. "Among the Indians," says an old missionary, "a verse, even when quoted inappropriately, gives a great weight to reasoning, and if it contains a comparison that seems to illustrate some circumstances of the subject under discussion the very best reasoning can not have equal force with the comparison." * In the same way Arabian orators fancy they obtain great force for their speeches by larding them with citations in verse; and the Greek writers believed it necessary to give the poetic form to every elevated subject, even to their philosophical systems.

During the primitive period of literary evolution abstract literature does not come in question; moreover, poetry in words is never separated from song, and rarely from mimicry; and this becomes dancing when the motions are controlled by a musical rhythm. Frequently, also, in these archaic festivals the words sung are only an accessory.

The characteristic traits of the clan, the first social unity, are now well known to us. The primitive clan is a small group, in which the individual exists only as an integrant part of the whole, where consequently all individual acts are subordinated to the interests and needs of the social body, where no one is abandoned but no one is free, where property is more or less common, and where sexual unions are subject to regulations that seem to us strange and even immoral, for they have usually a character of restricted, regulated promiscuity. These narrow associations have been real psychical laboratories to the human race, in which languages, indispensable for mutual understanding and the concentration of efforts, and myths have been created, besides common feelings, and particularly altruistic feelings, without which no society could endure.

In the communal clan there is little place for person and for literature, and literary æsthetics necessarily takes the shape of a collective spectacle—of those choral dances, those opera-ballets, in which all the members of the clan are in turn actors and spectators, and in which mimicry and song are associated to represent scenes of common interest.

In these very rudimentary dances instrumental music figures at first only as an accessory, but its function goes on increasing in proportion as it is perfected. At first it is contented with a stick, such as the Australians strike on the ground to mark the measure; then the stick is replaced by the tom-tom, which fills the same office more perfectly. To the tom-tom are added in succession, first, wind instruments, then stringed instruments, both becoming gradually less primitive and better constructed, and at

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* Lettres édifiantes, vol. xiii, p. 113.

least capable of accompanying the song, and, as a final achievement, of taking the place of the voice in the execution of any given air. History witnessed the latter part of this musical evolution in Greece, where music finally separated itself from vocal song, of which it had for a long time been only an accessory.

As of necessity, poetry proper has strictly followed the transformations of this æsthetics. For a long time the subjects represented in the choral dances of the clan had an entirely impersonal character. These subjects were mythological, warlike, funereal, and nuptial scenes, in which the rhythmical words had necessarily to express ideas and feeling in harmony with the scene played. It is not necessary to say that these feelings and ideas were extremely simple; but in substance and form they were of a nature to interest the whole of the little social groups.

The duration of the primitive age of the communal clan must have been enormous, and it has marked its impression on the larger and more and more individualist societies that came out from it, but which did not free themselves in a day from the hereditarily transmissible tastes and tendencies—the legacy of a long ancestral education.

Nevertheless, literary æsthetics has suffered modifications with the progress of social evolution; for it has had to express feelings and ideas more and more complex and varied. With the progress of differentiation, or of social inequality, arose numerous conflicts between the strong and the weak, the patrician and the plebeian, the rich and the poor.

These vexations, these violences, suffered by some and exercised by others, excited numerous new feelings, and often more personal, than the ancient choirs could express and re-echo to their hearers. The property thus became more and more individual, and there resulted from it a gradually increasing restriction of the social relations which the communal clan had only loosely regulated. The restricted promiscuousness of the early ages was replaced almost everywhere by a marriage, sometimes polygamic, sometimes monogamic, but legal, and making of women things possessed. The ancient liberty of love was abolished, but the genetic instinct is in its nature exacting and rebellious. When we attempt to chain it we excite passionate desires, intense feelings, that subjugate the whole mental life. The genetic fetters resulting from the new social organization will therefore arouse in the human brain new impressions and ideas of shades different according to the individuals. But all these psychical elements, at once new and intense, sought expression and reflection in a literature made in their image. Hence resulted the gradual blooming out of a new lyric poetry, which gradually tended to substitute itself for the choral lyric of the earlier ages.

From this phase dates amorous poetry, which was destined to take so large a development. There are good grounds for supposing that women may have especially participated in the creation of this lyric of the erotic kind. This is still the case in some Slavic countries and in Kabylia; and it is possible that in Greece Sappho only gave a brilliant personification to a more especially feminine literature, of which few specimens have come down to us. The lyric poetry of men is less confined to the domain of the amorous feelings. It touches more varied subjects and those of a more general interest, notably mythical and historical legends, capable of interesting a whole virile population, but possible to be versified and sung by isolated artists.

To accompany these individual songs of every kind, suitable instruments were needed, not noisy enough to drown the voice of the singer, but of sufficiently extensive register to follow all the shadings and modulations. Stringed instruments happily fulfilled this purpose; and thus all the superior races have invented or adopted them, while in Greece, one of them, the lyre, served to give a name to passionate and personal poetry.

By virtue of their improvement, literary arts, song, poetry and instrumental music became difficult of practice. To perform them required a special education, while in principle everybody could participate in the execution of the primitive choruses. Then appeared those popular artists, of whom the Hellenic rhapsodists, the Scandinavian skalds, and the Celtic bards are the best-known types, but of whom we find a few everywhere, even in tropical Africa, in Polynesia, and among the Tartar, Kabyle, Finnish, and Slavic populations.

At first these barbaric songsters limited themselves to following their own inspiration; but they were not slowly subjected to powerful influences. The priests on one side and the kings on the other attached them to themselves, and required them to sing the mythical legends or the achievements of their heroes and princes. Outside of these official subjects the professional bards took for the themes of their compositions everything of interest to their fellow-citizens that presented itself, and became thus the poetic annalists of all notable events. These poets, most frequently wanderers, were the first to give precise form to the popular traditions current among the people, and their songs, transmitted from generation to generation, constituted the material for the epics composed much later by less inspired but more skillful artists, at a period when epic customs were only a recollection.

We find many occasions showing how closely literature depends on the social and political state. At the origin of societies, during the age of the communistic clan, literature, always very poor, is the exact expression of what might be called the collective

soul. When the sacerdotal castes, aristocracies, and despotic monarchies have been instituted, when power and wealth are concentrated in the hands of a minority of privileged persons, the great revolution has an influence at once useful and injurious upon literature. Encouraged, corrupted, and exploited by the directing classes, by the worldly fortunate, poetry gains much in form and technics; meter ceases to be simple; the gross assonances of the past no longer suffice to charm more refined audiences; exact rhymes are required, and a skillful adaptation of syllables to a rigorously determined quantity. At the same time, poetical compositions cease to be only oral. They are written, and prosody must at once satisfy the eye and the ear.

The substance is modified along with the form, and becomes aristocratic like it. Certain gross features, which formerly shocked no one, are expunged; but with this the poem suffers a loss of its naïve grandeur, its sincerity of standard, its epic charm. When they undertook to protect and reward poets, the powerful classes ruled them always, even without desiring it; whether they knew it or not, they took them away from some subjects and imposed others upon them. On the whole, the final result of this high patronage is usually lamentable; and by the single fact of its existence, sincere, elevated, independent literature, the only kind that is of value, languished and expired under the rule of the "grand monarch," Louis XIV. What was left was only a shadow, an attenuated poetry, which chiseled out the form without caring for the material; which, having no ideas to express, juggled with the words, and saw nothing but the melodic side in the verse; in short, an inferior poetry, which tended to confound itself anew with its twin sister, music, which it had previously had to quit in order to think better.

The evolution of the dramatic art was effected in a nearly parallel line with that of lyric poetry. Even more rigorously than that, dramatic literature is the slave of the social state, because it has necessarily a collective character. In the course of our studies we have found the general opinion, according to which the theater is the literary expression of an advanced civilization, to be false. On the contrary, the dramatic species goes back to the very origin of literary æsthetics, for choral and mimic dances constitute nearly all the literature of primitive peoples, and a rudiment of scenic art has been found, even in Tasmania, among an extremely inferior race. In reality scenic poetry preceded all other kinds, and most frequently constituted their mold. By the simultaneous employment of mimicry, song, speech, and instrumental music, the opera-ballet of the early ages was the form of æsthetics most fitted strongly to impress spectators and actors, and at the same time to satisfy a very lively psychical want, that

of projecting mental images outward, of reproducing with all the relief of reality what exists in the brain only in the state of recollection or desire. The civilized theater is only the natural development of this opera-ballet, and it preserves an equal attraction and an equal power, even after losing the lyrical form, which dated from its origin.

Dramatic art was even more than lyric poetry subjected by the dominant classes; and in Greece, in India, and in Europe of the middle ages the clergy of the great religions seized such a powerful means of expression, confiscated it for a longer or shorter time, and even permitted it only with reluctance to become laic. Dramatic art being an essentially collective sort of literature, addressing itself to the multitude, could not express more than the average of the prevailing opinions, of the ideas current in the surrounding social medium; too original views, too special feelings, were not in its domain; in return it is, more than any other kind of literature, the reflection of the mental and moral condition of a class, accordingly as it is popular or aristocratic; and instead of correcting manners it continually confines itself to depicting them. In the golden age of Greece the theater was lyric and heroic; with social and political decay, Hellenic tragedy could not stand the competition of satirical comedy, which is a social protestation. At Rome, where social iniquity was at a very early period more crying than in Greece, the theater never had a heroic age.

In all times and in all countries literature has declined morally, and has lost its nobility, its force, and its æsthetic beauty, in periods of moral decomposition; but the first of all kinds of literature to be debased and corrupted was dramatic, for societies could not support any theater above their own standard. On the contrary, lyric poetry, compositions entirely personal, might protest as survivals for a longer or shorter time against the general decadence by expressing the sentiments of the minority, which will never bend to the new manners. In dramatic literature, or in literature in general, for the observation is true for all kinds, there is a sign of decadence no longer moral but intellectual, which is constant and which I will now point out. When we follow the evolution of literatures from their infancy to their old age, we are struck at seeing how, during their period of growth and vigor, they make little account of an æsthetic element, which is highly esteemed, on the contrary, in periods of decline; I mean what is called "the feeling of the beautiful in Nature." In the choral poetries this element is wholly wanting; they are preoccupied solely with mythical conceptions of subjects of social interest. In general, during the virile age of literatures, descriptions of landscapes hold only a very accessory place; on the other hand,

descriptive literature develops beyond measure during the period of decadence, as has been observed in China and India, where the excess and often the insipidity of the word-paintings overwhelm the chief subject of the poems. This belated taste for description seems, therefore, to be a characteristic symptom. It indicates that literary vigor is exhausted; that the writer has few ideas, or is restrained from expressing them; or that political liberty is dead, social sympathy is extinct, and intelligence is reduced.—*Translated for The Popular Science Monthly from the Revue Mensuelle de l'École d'Anthropologie.*

## THE PSYCHOLOGY OF LIZARDS.

By M. J. DELBŒUF.

I PUBLISHED two articles in February and October, 1891, telling of two ocellated lizards which I had captured in May, 1890—one at Port Bon, on the borders of Spain, the other on the banks of the Tarn, near Peyrdean, France. I described their characteristic differences at length, telling how the former lizard was bold, snappish, suspicious, and stupid; and the latter was timid, gentle, confiding, and straightforward. I told how the French lizard having been lost for twenty-six days in May of the following year, the Spaniard refused all food; and how, his companion having been found again, he went at once to catching flies. I praised their good understanding with one another, and their fellowship, which, however, did not extend to self-denial; and I related with great pleasure how, by forbearance and kind attention, I finally established excellent relations between myself and the Spaniard, while only a few delicate attentions were needed to gain the heart of the French lizard from the very first.

I concluded that the animals which we are accustomed to regard as in the lowest degree of intelligence among vertebrates, and which we are apt to suppose are all cast in a common mold, offer notable differences in character and docility. Yet, since those which are under consideration here are adults, they have necessarily each received the share of force and cunning which was indispensable to enable them to come safely out of the struggle for existence. Whence do their peculiar qualities come, and what use do they make of them? In wild animals, whose mode of life presupposes a well-determined combination of native qualities which age can only develop and strengthen, should not differences tend to disappear?

What I have to relate now is not less curious than my former

story. I do not even know—although like observations ought to be made on domestic animals like the dog—that the bearing of them as traits of animal psychology has been brought out. My Spaniard is certainly a lizard apart. He is somebody.

But before going into individual details, I will add the final to the incidents which I have already given concerning my lizards. I have had them three years, and they have kept in admirable health. They have not hibernated, for the house has been kept warmed all the time, and their cage has been near a register. They have therefore been all the time wide-awake and very active. From this we conclude that hibernation is not organic with them like the rest of plants, and that it is a consecutive of cold weather, which causes besides the disappearance of the insects on which they feed.

Their food, therefore, does not necessarily consist of living prey. They eat with the same appetite the remains of beetles, such as the skeletons of night borers, and all decayed or dried chrysalides. Last year, the cabbage butterfly being extremely abundant, I collected a stock of chrysalides which they devoured to the last one. They always refused raw and bloody meat. Nevertheless, when they were forced to swallow it, which was not easy, they digested it.

They are said to be fond of grapes, and in vine-growing countries, I was told, hunt for the fruit. But with me they never wanted grapes, not even the southern variety or the dried raisin.

On the other hand, they are fond of dates, and attacked them with avidity the first time they saw them. I made them up some balls of dates as large as a good-sized grape, of which they were able to swallow three or four one after another I received other ocellated lizards last year, and they all liked dates, one of them to my surprise gulping down a whole one in a wink. It agreed with him perfectly, his digestive powers, as I took pains to observe, proving adequate to dispose of the stone in a proper manner, although my friends feared that it would be caught in the sinuosities of the intestine, with perhaps fatal effects. It seems that this animal estimated rightly the capacity of his digestive apparatus. The preceding curious feature in the present case is that all the lizards at once recognized an eatable fruit in the date, although they had never seen or tasted dates or anything like them. They may have eaten figs at home, but they refused dried figs.

All my lizards lived, I might say, in freedom. During our summers in the country, they had a large room with latticed windows, with sunshine on three sides. They had stones and boxes of every sort, and for a gymnasium convenient scaffoldings furnished with rags in which they climbed, hid, and chased one another with evident amusement.

At Liége they live in my office. They usually keep in their cage, where there are also rags. When the sun is shining, they come out and scramble among the books or over me. The Spaniard looks at me when I am writing. They run over my person, hide in my clothes; and one day last year I had so completely forgotten them that I went out to deliver my lecture with my two animals on my back. I perceived them after I had been some time on the lecture stand, and was in mortal terror during the rest of the lesson, lest they might take a notion to perform their untimely and undignified gambols.

As my children, too, are fond of playing with them, they are always under observation. My articles have given them a European reputation. M. Tarde, the eminent sociologist and criminalogist, passed eight days with them. M. Forel, the celebrated student of ants, found them after a few days as interesting as his ants. They were intimate with a learned English psychologist, M. Waller, and his wife, and had the honor of being presented to eminent physiologists like M. Morat and great poets like M. Jean Aicond. They have even been invited into society and caressed by beautiful and noble ladies, whom they conquered by the grace of their motions and the beauty of their dress. Thus they have acquired gentle manners and are in safe and agreeable relations. Man inspires no fear in them, and they play indiscriminately with all visitors who encourage their familiarities.

When they play in the light and make turns in their gymnasium, going out, re-entering, putting their noses against the window, turning their pretty heads, or flattening their backs in the sun so as to receive more of its rays, they really present a charming spectacle; and I think, not without a shade of sadness, how nearly some countries would resemble a terrestrial paradise if man, instead of making himself the terror of everything living, would become its protector and friend.

All my lizards but one come at my call, whistle, snapping of the thumb, or *psitt*, to take flour worms or dates. They know where their larder is. When we go to the worm keg, they divine what it means, and are all on the alert, manifesting their expectation with unequivocal signs. The Spaniard, at first the most savage and stupid, became the most familiar and apparently on the best understanding. Not only was he not afraid of being taken, but he seemed to find pleasure in it, and suffered himself to be caressed for hours without giving a sign of weariness. He liked to be scratched under the jaw, however roughly.

The story of the way this transformation from wild to gentle was brought about is long but suggestive. MM. Sabbatier and Robert, of Montpellier, and M. Tarde had promised to send me ocellated lizards, but had not been able to fulfill their promise.

I was regretting it, when M. Winssinger, an engineer of Brussels, put me in communication with one of his friends, M. H. Dineur, Director of the Mines of Fillols, near Prades. He sent me an ocellated lizard on the 1st of October, 1891. This lizard died by being inadvertently smothered, at the end of March in the next year. The autopsy disclosed that it was a female; it weighed only fifty-six grammes, while the Spanish lizard weighed more than one hundred and thirty grammes, and the one from the Tarn more than ninety grammes. The Spanish lizard was a male.

It possibly came to pass that the young female disturbed the harmony between the Spanish and the French lizards, for I observed that they no longer lived on a footing of complete intimacy. I observed at first only scoldings between them, but these were succeeded by bitings. In the beginning the quarrels were transient, but they became more and more frequent, and the acts of hostility were graver—the Spanish lizard, presuming on his strength, pursuing his rival, driving him out of corners, biting him, and at last rendering his existence so miserable that I was obliged to separate them. After the tragic death of the lizard of Prades, I hoped there would be a reconciliation, but there was none. The French lizard, indeed, made several attempts to establish peace, but the Spaniard sprang upon him furiously as soon as he perceived him and made him scamper his fastest.

M. Dineur sent me other consignments of lizards, six in all. One very small one escaped into the field; another died a little while after its arrival. It was a very fine animal, but it had sharply bitten a workman who picked it up, and the stupid and cruel brute took his revenge upon it by making it bite a bar of red-hot iron. Its mouth was all a sore when I received it, and it survived its horrible burning only a few days.

Among the four new lizards that were left me was one formidable one, which, although it lost most of its tail when it was captured, still weighed nearly two hundred grammes. They very soon became familiar, except one, which, while it would eat from the hand, persisted in running away if one tried to pick it up, and bite when it was captured. The Spanish lizard received them hospitably, but if I put the French animal among them he would immediately recognize him and chase him.

But after some weeks of peaceful living together, the Spanish lizard began to tyrannize over his new companions too, the largest at first and then the smaller ones. He is a decided teaser and a bad bedfellow. Nothing can be more curious then the tactics he employs to cut off their retreat. He turns himself crosswise, in such a way as to bar their passage. Then, when he has driven them into a corner, he lifts up his paws, swells out his neck, puts down his head, darts his great open mouth at them,

and bites them on the head, the flanks, seldom on the paws or tail. The large lizard in particular was the favorite object of his attacks. The good-humored animal paid no attention to this, till we were on the point of asking ourselves whether he did not regard these bitings as marks of friendship. This lasted some two or three months. But one fine day—we were present at the scene—the large lizard became impatient. He seized the Spaniard with his formidable mouth, shook it, let it go, and then set in chase of it. The other ran off as fast as he could, giving all the signs of terror. After this the large lizard became quiet, and even seemed to have forgotten the matter.

The Spaniard took no notice of the generosity of its antagonist. Only becoming more prudent, it devised other tactics. Pretending indifference, it approached the Hercules slyly and a step at a time, and when it was near enough to him struck him with its jaw and ran away. Finally, the large lizard concluded that the Spaniard was too provoking; he sprang upon it anew, caught it, and gave it a forcible blow. After that the Spaniard regarded itself as beaten, always fled at the approach of the large one, and let him alone. After that, too, it prepared to make its attacks and bitings on the smaller ones. Its bad character became the cause of its being given a privileged position. It was put in the cage only while the others were allowed to be at large. If it sees us playing with them, it comes and goes into its cage like a troubled soul, and vents its anger upon the trellis. It is exceedingly jealous, and its jealousy blinds it so much that it could not refrain from still taking its satisfaction out of the large one if it saw him running over me. The rest of the time it played freely, and did not abuse its liberty in any other way. It usually perches on its cage by the side of the chest furnished with rags, which serves as its sleeping-room. Toward three or four o'clock in the afternoon it regularly goes to bed, and comes from it habitually toward sunrise. Is not this a singular history; and does it not show that animals have passions, preferences, and antipathies, differences of character and changing moods which we have thought exclusively applied to men?

We now come to traits of intelligence. The cover of the Spanish lizard's chest slides. If it is pushed so as to leave a crack not large enough for him to go through, he works perseveringly, pushing his head into it till he has made it large enough. If the opening is too small for that, he scratches at it and makes a great noise with his paws, for the purpose, apparently, of making himself heard. In the same way sparrows knock on the windows of houses where they are accustomed to being fed. This reminds me of a story of a sparrow.

Several years ago I tamed one in the country. It was free in the

garden and came at my call. If I did not call, it came all the same. As I was accustomed to have hemp seed in my mouth, it would peck at me, picking my beard and mustache furiously till I had satisfied its appetite. It was satisfied that it had tamed me and made me its slave. My lizard is nearly in the same condition. It does not molest me, but when I take the box of worms it rises and snaps them from my hand and even from the box. It is well persuaded that man is the friend of the lizard. It has a delicate ear. When it is called from the end of the room, it turns its head to the right and the left, as if to get its bearings and find the direction whence the sound comes. It can hear the walk of an insect and a worm crawling on the ground. Its vision is likewise good, and it recognizes a meal-worm from a considerable distance.

The other lizards like their cage; and toward three or four o'clock in the afternoon they will all, if they are, for example, on the table, start to come down, using the chains to help their descent to the ground, and then climbing back into their abode and hiding by choice in their rag houses.

The Spaniard, notwithstanding his jealous, vindictive, and vengeful character, is more petted than the others, because we have him constantly in hand, and he is the easiest to take up and exhibit. For this reason too he is best at the little tricks we teach them. But, in view of the stupidity he manifested for several months, there is no doubt that the others, which, as I have said, with one exception became gentle and trustful in two or three days, if they had been the objects of the same careful attention, would have given still more marked proofs of capacity for education. If I turn the Spaniard on his back and make a sign to him with my finger, he will remain there for some time, but not without showing some impatience and raising his head. The animal is obedient to force, however mildly it may be exercised, but such obedience is a sign of reasoning.

It can not be denied that all its ways have a perceptible resemblance to those of the dog, particularly if we take into the account its poverty of means of expression. I saw in the London Zoölogical Gardens an Australian lizard, high on its legs, with the bearing and head of a greyhound, and very pleasant large eyes. I have forgotten its name. It impressed me as being easy to educate, so far as I could judge of lizards by the face. And what might we not get from large lizards if we should succeed in forming a domesticated race? We should not forget that my animals were captured adult. The conclusion of my long story is that the enormous intellectual differences which we usually assume as between reptiles and the highest mammals probably do not exist, and consequently that there is in the brain of reptiles sufficient avail-

able matter to permit them to adjust themselves to a certain degree of domesticity or to sociability; and it is the social state which, other things being equal, is the highest product of animal as well as of human intelligence.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

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## SKETCH OF HENRY CARRINGTON BOLTON.

THE New York Academy of Sciences, founded in 1817 as the Lyceum of Natural History, is the oldest and most influential scientific society in the city. During a period of seventy-six years it has had but six presidents, viz.: Dr. Samuel L. Mitchill, who served seven years; Prof. John Torrey, four years; Major Joseph Delafield, thirty-eight years; Prof. Charles A. Joy, two years; Prof. John S. Newberry, twenty-four years; Prof. Oliver P. Hubbard, one year. At the annual election held February, 1893, Prof. Henry Carrington Bolton, Ph. D., was elected the seventh president.

HENRY CARRINGTON BOLTON was born in New York city, January 28, 1843, being the son of Jackson Bolton, M. D., and Anna Hinman, daughter of Elisha North, M. D., of New London, Conn. From both his paternal and maternal ancestors Dr. Bolton inherits traits that co-operate to give him scholarly tastes and stability of character.

The family of Bolton is among the few English ones able to show their descent from a period not far removed from the Conquest (1066). The extensive Yorkshire domain, from which the family derived its name, is mentioned in Domesday, and in 1135 Oughtrede de Bolton appears as Lord of Bolton and Bowbearer of Bowland Forest. From their estates in the charming Ribble Valley, near the southern border of Lancashire, the family spread through Yorkshire and adjoining counties, bestowing their name on many a dale and infant vill, so that to-day there are seventeen places in England known as Bolton, with or without distinguishing suffixes. From earliest times the Boltons were yeomen and tradesmen, but many of their sons entered the service of the Church, and not a few of them became eminent for scholarship.

In 1530 the direct ancestors of Dr. Bolton were living on an estate called Brookhouse, near the town of Blackburn, Lancashire, and from them he traces his descent without a missing link in the chain. In 1718 one of the family left England and settled in Philadelphia; his son and his grandson became prominent shipping merchants in Savannah, Ga., the latter taking into partnership his nephew Curtis, grandfather of the subject of this sketch.

Curtis Bolton subsequently removed to New York and became the head of the firm of Bolton, Fox and Livingston, owners of the Havre line of packets. Curtis married his cousin, Ann Bolton, daughter of Robert, of Savannah; their third son, Jackson, was graduated at Columbia College in 1833, and later at the University of Paris, where he received the degree of D. M. P. Dr. Jackson Bolton practiced his profession with success for over twenty years in New York city, and was also Vice-President of the New York Academy of Medicine and President of the Pathological Society.

That branch of the North family into which Dr. Jackson Bolton married had been residents of New England for two hundred years; the male ancestors of Dr. H. C. Bolton's mother for three generations had been physicians, the last in the line being Elish North, M. D., of Goshen, later of New London, Conn. Dr. North is remembered as among the first in America to practice vaccination, at Goshen, in 1800; as the first physician to open an eye infirmary in the United States; and as the author of works on Spotted Fever (New York, 1811) and on physiology, 1829.

Henry Carrington, the only child of Jackson and Anna H. Bolton, was born in his paternal grandfather's house, No. 58 Greenwich Street, New York city, at the date above given. The vicinity was the court end of the town, and the boy's earliest playground was the Battery. Later, his father moved up town, and the Battery was replaced by Union Square. Dr. Bolton's primary education was in private schools, and he has been heard to mention with deep gratitude the excellent training and kind consideration of Mr. George Stowe, who laid secure foundations in English studies. At the age of nineteen Dr. Bolton, in 1862, was graduated at Columbia College; he took no distinguished place in his class, but showed marked aptitude for mathematics, and for chemistry when the latter study was reached in the curriculum. Prof. Charles A. Joy, who held the chair of Chemistry at that time, had been prohibited by the trustees of Columbia from admitting students to practical work in the small laboratory adjoining the lecture-room, and Dr. Bolton was debarred from studying chemistry in a rational way; to supply this deficiency, however, his father provided him with simple apparatus and a few chemicals at home, where he attempted to apply the principles learned from the lectures of Prof. Joy. Very different from this the present methods at Columbia College.

Going to Europe immediately after graduation to continue his study of chemistry in foreign universities, young Bolton spent one year in Paris, first in the laboratory of the Sorbonne, then in charge of J. B. Dumas, and afterward in the laboratory of the École de Médecine under Adolphe Wurtz.

In 1863 to 1865 he continued his studies in Germany: at Heidel-

berg he worked in the university laboratory under the guidance of Bunsen, and attended lectures by Kirchhoff, Kopp, and Von Leonhard; during his sojourn in Heidelberg he took no part in the objectionable practices of the "Studenten-Corps," yet became so popular in the laboratory that at the beginning of the third semester he was elected by the students their "Polizei."

After a summer semester in Göttingen under Friedrich Wöhler, where he began research for a thesis, he went to Berlin, where he was admitted to the private laboratory of Prof. A. W. von Hofmann, the university laboratory not being as yet constructed. His position under Hofmann was a most agreeable one, and may be called that of pupil-assistant, as he worked at researches for Hofmann without any pecuniary compensation either to or from the university. For six months he was the sole pupil with Hofmann, but later he shared his table with the late Dr. Paul Mendelssohn-Bartholdy. In 1866 he took the degree of Doctor of Philosophy at Georgia Augusta University, Göttingen. Dr. Bolton's residence in Berlin was saddened by the death of his father, after a lingering illness, February, 1866.

During his five years' sojourn in Europe Dr. Bolton spent the long summer vacations in travel, chiefly in Switzerland and the Austrian Tyrol; he visited every canton in Switzerland on foot, and became an expert Alpine climber, ascending among other peaks the Titlis, the Col du Géant, the Cima di Jazzi, and Monte Rosa.

In the years 1866 and 1867 he made more extended journeys, traveling leisurely in Italy, Spain, France, Holland, Russia, and Scotland. In August, 1867, he returned to the United States, and, continuing his travels, went from Canada to Mexico. Settling in New York the following year, he opened a laboratory for private research, and eventually took a few pupils. In 1871 he spent five months in travel, visiting California and Washington Territory. In 1872 he was invited to the position of assistant in analytical chemistry at the School of Mines, Columbia College, under Prof. Charles F. Chandler. This position he accepted, and he had charge of the laboratory of quantitative analysis for five years, also giving lectures on the subject during the last year. Meanwhile, in 1875, he was elected to the chair of Chemistry in the Woman's Medical College of the New York Infirmary, of which Dr. Elizabeth Blackwell is dean; here he discharged his duties for three years, until he removed from New York city.

In 1877 he accepted the chair of Chemistry in Trinity College, Hartford, Conn., a position which he held for ten years. At Trinity he planned the interior of the chemical department and moved the apparatus and museum to the new buildings. He had marked influence in the organization of scientific courses, in which he had the co-operation of the late Prof. Louis M. Cheesman, who held

the chair of Physics at that time. As his duties in Trinity required him to teach mineralogy, he formed a collection of minerals, numbering about three thousand specimens, gathered largely by his individual exertions in the field.

As a teacher he strove to impart knowledge in an attractive way, believing that, by combining entertaining diversions with serious instruction, students would both comprehend and retain facts better than if presented in a dry, formal manner. Whenever it was possible he availed himself of object teaching; although he allowed in the class-room temporary displays of humor, his pupils understood that this was to be enjoyed and not abused, and always showed their teacher sincere respect. The experience gained in teaching analytical chemistry at the School of Mines he combined with the methods in vogue when he was called to the position of assistant, and the results he published in a volume entitled Student's Guide in Quantitative Analysis (New York, 1882; third edition, 1889).

In 1885 the President of the United States appointed him an assay commissioner.

While engaged in instruction Dr. Bolton carried on a number of original researches in chemistry, of which the more important are his investigations on the salts of the rare metal uranium, the results of which he published in several papers, 1866–'70. In 1872–'73 he assisted President Henry Morton, of the Stevens Institute of Technology, in researches on the fluorescent and absorption spectra of uranium salts, preparing a large number of compounds, including several new to science; the published results are in their joint names (American Chemist, 1873).

Between 1877 and 1882 he published three memoirs on the Application of Organic Acids to the Examination of Minerals (Annals of the New York Academy of Sciences), in which he showed the power of the organic acids in decomposing minerals, as well as their utility in determining varieties based upon definite reactions. He directed attention to the advantage of dry citric acid over the liquid mineral acids in geological field-work, owing to the perfect safety of transportation of the former. These methods have been incorporated in the last edition of Elderhorst's Manual of Blowpipe Analysis. The space at our disposal precludes mention of several minor original observations.

Dr. Bolton early in his studies felt the need of those important keys to knowledge, bibliographies, and has devoted much labor to the preparation of special and general works of this nature. His first effort in this direction was an Index to the Literature of Uranium, published in the Annals of the New York Lyceum of Natural History in 1870; this reached a second edition in 1885 (Smithsonian Annual Report), and has formed the model on which

a score of similar indexes to special topics have been produced. In 1876 he published an Index to the Literature of Manganese.

At the Montreal meeting of the American Association for the Advancement of Science (1882) he chose for his vice-presidential address the subject Chemical Literature, and suggested the formation of a committee on indexing chemical literature; as the chairman of this committee he has prepared ten annual reports to the association, and has done much to encourage the production of special chemical bibliographies by American chemists.

One of the most important bibliographical works by Dr. Bolton is his Catalogue of Scientific and Technical Periodicals, 1665–1882, published as vol. xxix of the Smithsonian Miscellaneous Collections in 1885. This comprises full titles of over five thousand scientific technical journals in about twenty languages, together with chronological tables showing the year of issue of each volume of five hundred periodicals, and a library check-list indicating in what American libraries sets of these journals are to be found. This undertaking was a labor of love on the part of Dr. Bolton, who, in the words of an eminent writer, acquired thereby "a place in the foremost rank of those little-appreciated and hard-worked men, bibliographers." Dr. Bolton has just completed a still more extensive work of a kindred nature, A Select Bibliography of Chemistry, 1492–1892. This general bibliography of chemical science comprises over twelve thousand titles in twenty-four languages, yet is a "select" catalogue, and makes no claim to completeness. The titles are arranged under seven groups, as follows: I, Bibliography; II, Dictionaries; III, History; IV, Biography; V, Chemistry, pure and applied; VI, Alchemy; VII, Periodicals. The volume contains 1212 pages, and forms No. xxxvi in the series of Smithsonian Miscellaneous Collections.

Parallel with his original researches and bibliographical compilations Dr. Bolton has given much attention to the history of chemistry, contributing many notes to current scientific journals, of which the following is a partial list:

*Contributions to the History of Chemistry.*—Historical Notes on the Defunct Elements, American Chemist, 1873. Views of the Founders of the Atomic Philosophy, American Chemist, 1873. Notes on the Early Literature of Chemistry, several papers in American Chemist, 1873–'79. Papyrus Ebers, the earliest medical work extant, Quarterly Journal of Science, London, 1876. Ancient Methods of Filtration, The Popular Science Monthly, 1879. Early Practice of Medicine by Women, The Popular Science Monthly, 1880. History of Chemical Notation (two papers), Transactions of the New York Academy of Sciences, 1883. Recent Progress in Chemistry, Transactions of the New York Academy of Sciences, 1886. The Lunar Society of Birmingham, Transactions of the

New York Academy of Sciences, 1888. The Likenesses of Joseph Priestley in Oil, Ink, Marble, and Metal, Transactions of the New York Academy of Sciences, 1888. The Contributions of Alchemy to Numismatics, American Journal of Numismatics, 1890. Progress of Chemistry as depicted in Apparatus and Laboratories, Transactions of the New York Academy of Sciences, 1893. An Account of the Progress of Chemistry for the Years 1882 to 1886, prepared annually for the Smithsonian Institution, 1882–'87. The last four contain bibliographies for their respective years.

Dr. Bolton's interest in the history of chemistry took practical shape in 1874, when he originated and organized the Centennial Celebration of the Discovery of Oxygen by Dr. Joseph Priestley, held August 1st at Northumberland, Pa.; on this occasion seventy chemists from all parts of the United States and Canada assembled around Priestley's grave to do him honor. The proceedings at this memorable gathering were printed in full in the American Chemist (1875). The acquaintances formed at this meeting with the descendants of Dr. Priestley were continued by Dr. Bolton, and through them he eventually secured a number of unpublished letters of the distinguished chemist; these letters he edited and published in a volume bearing the title: Scientific Correspondence of Joseph Priestley; New York, privately printed, 1892.

In 1882 a casual visit to the so-called "singing beach," at Manchester-by-the-Sea, Mass., made him acquainted with the peculiar natural phenomenon of musical sand, and, finding its study had been almost wholly neglected, he began an investigation which eventually led him to make journeys aggregating thirty-three thousand miles in search of sand having musical properties. Early in the research he secured the assistance of Dr. Alexis A. Julien, of Columbia College, to whose skill with the microscope he is greatly indebted. Jointly with Dr. Julien he has published several abstracts of papers on Musical Sand (Proceedings of the American Association for the Advancement of Science, and Transactions of the New York Academy of Sciences), which have been widely noticed in current literature.

The following papers, on topics of very wide range, can not be classified more narrowly.

*Sundry Scientific and Literary.*—Magic Squares, their History, Preparation and Properties (six papers), Acta Columbiana, 1874. The Log-book of the Savannah, Harper's Magazine, 1877. Legends of Sepulchral and Perpetual Lamps, Monthly Journal of Science, London, 1879. Microscopic Crystals in Vertebræ of Toads, Proceedings of the American Association for the Advancement of Science, 1880. A Handy Multiplication Table, American Teacher, 1885. The Life and Writings of Elisha North, M. D., Transactions of the Connecticut Medical Society, 1887. Scientific

Jottings on the Nile and in the Desert, Bulletin of the American Geographical Society, 1890. Historical Notes on the Gold-Cure, Popular Science Monthly, 1892. A Plea for a Library of Science in New York City, 1893. Russian Transliteration, American Library Journal, 1893.

In 1886 Dr. Bolton became interested in folk-lore, and published two years later a work bearing the title, Counting-out Rhymes of Children (London, 1888), which brought him at once into prominence as a folk-lorist. Since then he has contributed occasional papers to the Journal of American Folk Lore, of which the most notable are the two following: Some Hawaiian Pastimes (1891) and A Modern Oracle and its Prototypes (1893). His work on Counting-out Rhymes was awarded a bronze medal by the Columbian Historical Exposition held at Madrid in 1892.

After the death of his mother in 1887, Dr. Bolton resigned from Trinity College, retired from teaching, and resumed his residence in New York city. He has been able to indulge his love of travel by frequent journeys abroad; besides the five years' sojourn in Europe already named, he visited in 1873 the principal libraries of England, France, and Germany, to collect material for his Bibliography of Scientific Periodicals, the publication of which was, however, from various causes delayed until 1885. In 1880 he visited Norway, Sweden, and Denmark; in 1887 and 1888 he made a second and a third bibliographical tour in Europe; in 1889 he visited Egypt, going as far as Mount Sinai; in 1890 he visited the Bermudas and the Hawaiian Islands. These distant points were visited in search of "musical sand." In 1891 he again crossed the Atlantic, chiefly for research in libraries. Dr. Bolton has been heard to say he never travels to kill time or to satisfy mere curiosity; he always has some definite object in view and works harder on his journeys than otherwise.

Dr. Bolton is often called upon to give illustrated lectures on his travels and on popular science. Being an amateur photographer he brought back with him from Arabia Petræa and from the Hawaiian Islands many excellent negatives with which he illustrates his lectures. These include the following subjects: Four Weeks in the Desert of Sinai, Life and Scenes in the Hawaiian Islands, Picturesque Scenes in Norway, Alchemy the Cradle of Chemistry, The Counting-out Rhymes of Children, The Glaciers of Switzerland, Musical Sand, etc.

In 1892 he was elected by the Trustees of Columbian University Non-resident Professor of the History of Chemistry, and in the discharge of his duties gave in March, 1893, a course of nine lectures on the history of chemistry. He treats this subject in a graphic way, making it attractive to the general audience by illustrating every step with the lantern.

Dr. Bolton joined the Lyceum of Natural History of New York City in 1867 and has been an active member for twenty-six years. He was one of the committee (with the late Dr. John S. Newberry and Prof. B. N. Martin) who accomplished in 1876 the change of name to the New York Academy of Sciences by which it is now known; from 1876 to 1877 he held the office of corresponding secretary; from 1887 to 1892, of recording secretary; from 1892 to 1893, vice-president; and in 1893 president. He has also been prominent in the national society, the American Association for the Advancement of Science, frequently serving on its council and on committees, besides holding the office of Secretary of the Chemical Section (1876), Secretary of the Council (1889), general secretary (in 1878, 1879, and 1890), and vice-president (1882). Dr. Bolton was one of the founders of the American Folk-lore Society in 1887, and has been on the council of the society to date. He is also president of the New York branch of the American Folk-lore Society established in the spring of 1893. He has been a member of the Executive Committee of the New York Section of the American Chemical Society since its foundation.

To all these societies Dr. Bolton has frequently contributed papers; including communications of literary and general character printed in journals, they number more than a hundred and fifty. He has been influential in shaping the policy of the Council of the Scientific Alliance of New York City, and was made its treasurer in 1893.

Dr. Bolton is a member of many learned societies besides those above named, the chief being as follows: German Chemical Society of Berlin, Chemical Society of Paris, National Society of Natural and Mathematical Sciences of Cherbourg, American Society of Naturalists, Numismatic and Antiquarian Society of Philadelphia, American Metrological Society, Brooklyn Institute, corresponding member of the Rochester Academy of Sciences, and honorary member of the Elisha Mitchell Scientific Society of Chapel Hill, N. C.

He founded the 'Ology Club in Hartford and the Lunar Society in New York, social clubs for scientific discussions and mutual admiration. He is a member of the University Club of New York and of the Cosmos Club of Washington.

Dr. Bolton's private library, though numbering less than one thousand volumes, is probably unique in the United States, being devoted to the history of chemistry. It is rich in original works on alchemy and early chemistry, besides containing a collection of several hundred portraits of scientists of all countries and all time. At the request of the Grolier Club of New York city, he made an exhibit of a selection from his library in their club house in January, 1891.

# CORRESPONDENCE.

## MAJOR POWELL ON "ARE THERE EVIDENCES OF MAN IN THE GLACIAL GRAVELS?"

*Editor Popular Science Monthly.*

SIR: The article by Major Powell, which appeared in your July number, calls for a few words of comment. It was written apparently as an indirect reply to our own paper in the April issue. But it contains little more than a restatement of some elementary truths in geology, which, however new they may be made to appear by the art of the writer, are really somewhat ancient, and form a part of the stock of every tyro in the science.

To this, however, no one can properly object. Major Powell is entitled to write whatever he chooses. But bad logic and misrepresentation of authorities are not legitimate argument, and in a few points where the distinguished head of the United States Geological Survey touches upon topics which we referred to in the former article we may be allowed to criticise his statements.

In the first place, the major is in error in misconstruing our words into an attack on the United States Geological Survey. No fair construction of the language will support this charge. Our chief purpose was to expose and condemn the tone and spirit of the reviewers whose assaults we criticised, and especially the language in which one of them had seen fit to express his opinions. For this latter words too strong could hardly be found. What sentiments have been awakened by it in the minds of geologists, both in America and abroad, we can imagine. They must be both amused and amazed to see a member of the Geological Survey of a great and enlightened country so far forgetting the dignity and responsibility of his office as to indulge in invective and vituperation against a fellow-worker in the scientific field.*

Major Powell's paper is in striking contrast to that of his subordinate in being perfectly courteous. We could expect nothing else from him. Had all the critics of Prof. Wright been equally dignified and gentlemanly there would have been no ground for objection.

We confess, however, to a feeling of regret that the director stopped short of any remark indicating disapproval of the language that had been used by a member of his staff. We can not bring ourselves to believe that he sanctions it, but his silence lends it at least an indirect support. We think that a word of this kind would have done the Survey a greater service than any attempt to defend it where it was not attacked, or any discourse on the harmony and courtesy which have, he tells us, characterized its discussions up to date.

Major Powell makes but little direct allusion to us, though his paper was evidently called out by our article. He contents himself with the general assertion, or rather implication, that "every paragraph is based on error." Such sweeping charges are easily made, and are often as erroneous as easy. Not a single error is adduced, and the inference from this omission is not difficult. At all events, it will be soon enough to defend the paragraphs when they are definitely attacked.

Meanwhile, we propose to investigate a few passages of Major Powell's article, in order to see if the critic is himself above reproach, and to discover if any erroneousness lurks concealed within his own paragraphs. Space will not allow more than this. But unless his arguments are better than those of his comrades and subordinates, he will be but a poor ally to aid them in their cause.

Major Powell refers to the Nampa image. Now, it was and is no part of our plan to defend this "find." It is no bantling of ours. We leave it to the tender mercies of others more competent. We merely pointed out in the former paper the fallacy of the arguments used by the writer to whom we referred in his attack upon it and on Prof. Wright. Though Major Powell has failed, probably for the very best of reasons, to give the exact details for which we called, yet his words sufficiently prove the inacuracy of the story, as given in the American Archæologist and in the Literary Northwest. It is a pity also that Major Powell has allowed himself to misrepresent the evidence for want of reference to the original documents in the Proceedings of the Boston Society of Natural History. His language leads the reader to infer that he was not even aware of their existence, inasmuch as he says that his greatest surprise on reading Prof. Wright's second book was to find that the image had fallen into his hands and was used as an argument in favor of the antiquity of man. This was two years after the original publication by Prof. Wright, and his arguments were by this time familiar to all students of American archæology.

* It is deeply to be regretted that this same official has seen fit to repeat and thus to exaggerate his offense by putting out, since our article was written, a second paper of similar tenor. Though a copy of this was in our possession at the time of writing, we could not justly refer to it, as it had not then appeared. We also hoped that the author's good sense would lead him to acquiesce in its suppression for the sake of American science and his own reputation. This hope was, however, disappointed.

But let this pass. Major Powell writes on another page of a human skeleton alleged to have been found in a bluff excavated by the Mississippi River in the loess that borders its channel. He says:

"The loess is a formation contemporaneous with the glacial formation of the north. The discovery of a human skeleton in this situation was believed to prove that man dwelt in the valley of the Mississippi during the loess-forming period. The discovery seemed of so much importance that the site was visited by Sir C. Lyell, who, on examination, at once affirmed that the skeleton was not found in the loess itself, but in the 'overplacement,' or modified loess—that is, in the talus of the bluff—and all geologists and archæologists have accepted the decision."

We fear that this circumstantial story on examination will prove to be similar to some other evidence that has been brought forward in the current discussion, and it is with no little surprise that we see so prominent a geologist advancing arguments so weak and testimony so garbled. But we will for a moment waive this objection. Assuming that Sir C. Lyell did express the opinion here maintained by Major Powell, we may be allowed respectfully to remark in passing that if that geologist was able so easily and so long ago as 1846 to distinguish between the bluff and the "overplacement," it is a little late to claim the criteria of this distinction as a discovery of any geologist or any body of geologists in the present day. This is a discovery of the already discovered, an appropriation of the "finds" of other men, equal to any of the wonderful deeds related in the travels of the renowned Captain Brazier. Sir Charles must have been born too soon—at least forty years ahead of his time. The geological world of America has only just come up to him.

But returning to our main line, we can not even at this point allow Major Powell's argument to rest. A regard for logic compels us to tax him with carelessness and inaccuracy, if not with misrepresentation, in his references to Sir Charles Lyell. He refers as above to that author's Second Visit to the United States. How correctly this is done a comparison of his words with the following extracts will show.

Lyell writes, in the Antiquity of Man (p. 203):

"Mingled with the bones of mastodon, megalonyx, equus, and others, the pelvic bone of a man was obtained. It appeared to be in the same state of preservation and was of the same black color as the others, and was believed to have come like them from a depth of about thirty feet from the surface."

"In my Second Visit to America in 1846 I suggested, as a possible explanation of this association of a human bone with remains of a mastodon and megalonyx, that the former may possibly have been derived from the vegetable soil at the top of the cliff, whereas the remains of the extinct mammalia were dislodged from a lower position, and both may have fallen into the same heap or talus at the bottom of the ravine. Had the bone belonged to any recent mammifer other than man, such a theory would never have been resorted to."

Lyell's very words in the original work read thus: "I could not ascertain that the human pelvis had been actually dug out in the presence of a geologist or any practiced observer, and its position unequivocally ascertained. Like most of the other fossils, it was, I believe, picked up in the bed of the stream, which would simply imply that it had been washed out of the cliffs. But the evidence of the antiquity of the bone depends entirely on the part of the precipice from which it was derived. It was stained black, as if buried in a peaty or vegetable soil, and may have been dislodged from some old Indian grave near its top, in which case it may have been only five, ten, or twenty centuries old; whereas if it was really found *in situ* at the base of the precipice, its age would more probably exceed a hundred thousand years."—(Second Visit, chap. xxxi.)

The wide discrepancy between the language of Lyell and its interpretation by Major Powell is obvious. There is absolutely no justification for the assertion that Lyell "at once assigned the bone to the talus." He evidently resorted to this possible explanation to avoid what was in 1846 a yet more formidable difficulty—the admission of the great antiquity of man. Lyell's so-called evidence must therefore be thrown out of court. His decision on the point is purely fictitious, and the statement that "all geologists and archæologists have accepted it" is merely a fiction based on a fiction.

But the criticism must not in justice end even here. It is not fair in so rapidly advancing a science as geology to quote the words even of a leader published nearly fifty years ago, without any intimation that he afterward changed his opinion. Lyell was a man who grew with the times in which he lived. The palæoliths from the gravels at Amiens were cardinal evidence to him, and supported as they then were by similar though less conclusive testimony from other places, they worked his conversion to the doctrine of the great antiquity of the human race, a belief in which he never afterward wavered. His belief found a place in his writings. He revised or even recanted his former opinions wherever he thought them erroneous, and his great work, The Antiquity of Man, is at once a monument of his candor and of his progress. Had Major Powell taken the trouble to consult this volume, with which we must suppose that he is familiar, he would scarcely have dared so completely to misrepresent its author as he has done. He has laid himself open to at least

the charge of gross carelessness in citation of testimony, and his paragraph is "manifestly founded on errors" for which it is hard to find any plausible excuse.

Lyell writes in the chapter already quoted, when referring to this fossil (which, by the way, was not, as Major Powell says, a human skeleton, but merely a broken pelvic bone):

"After visiting the spot in 1846, I described the geological position of the bones and discussed their probable age with a stronger bias, I must confess, to the antecedent improbability of the contemporaneous entombment of man and the mastodon than any geologist would now be justified in entertaining" (p. 200). "My reluctance in 1846 to regard the fossil human bone as of post-pliocene date arose in part from the reflection that the ancient loess of Natchez is anterior in time to the whole modern delta of the Mississippi . . . . If I was right in calculating that this delta has required more than one hundred thousand years for its growth, it would follow, if the claims of the Natchez man to have coexisted with the mastodon are admitted, that North America was peopled more than a thousand centuries ago by the human race. But even were that true we could not presume, reasoning from ascertained geological data, that the Natchez bone was anterior in date to the antique flint hatchets of St. Acheul . . . . Changes of level as great as that here implied have actually occurred in Europe during the human epoch, and may therefore have happened in America . . . . Should future researches, therefore, confirm the opinion that the Natchez man coexisted with the mastodon, it would not enhance the value of the geological evidence in favor of man's antiquity, but merely render the delta of the Mississippi available as a chronometer."

The principles of exegesis which allow the extraction from these words of an affirmation that the bone was not found in the loess but in the "overplacement" are decidedly original and may be valuable in a case of urgent need. They recall to one's mind Prof. Huxley's satire on the Hebrew language. A case that stands in need of logic so bad and of quotation so erroneous must indeed be in a sorry plight. Sir C. Lyell evidently had no intention of denying the antiquity of the human pelvis. With characteristic caution he suspended judgment, and no one has any right to wrest his language in either direction. Whether ancient or not ancient, whether fraud or forgery or fact, matters not here. Testimony has been misquoted and authority misapplied. We plead not here for the genuineness or antiquity of the Mississippi man, but for fairness in logic and accuracy in statement.

We can not avoid the impression that in another place Major Powell somewhat transgresses the limits of accuracy where he says:

"Prof. Wright stands almost alone in his advocacy of a scientific doctrine. He has a few sympathizers and some defenders of some portions of his theory, but the great body of his work is repudiated by nearly every geologist in America and especially by the professorial corps."

The latter part of this extract may be true, but so far as they have declared themselves the following may rightly be claimed on his side: Dana, Hitchcock, Emerson, Crosby, Upham, and Bell. Others, in view of the pending discussion, await further evidence. Abroad a longer list of names may be drawn up, including that of the venerable Prestwich, ex-Professor of Geology at Oxford, Hughes, of Cambridge, Lamplugh, Crosskey, Kendall, and Dugald Bell in Great Britain, Falsan in France, Credner and Diener in Germany, Holst of Sweden, and Nitikin, state geologist of Russia. Sir H. H. Howorth says in a recent work,* "While the theory of a plurality of glacial periods has found several advocates in Germany, the French geologists are virtually unanimous on the other side." With such a list Prof. Wright stands "alone" in good company.

The scientific imagination is a faculty of the highest order and of great value so long as it is held in check by reason and knowledge. But when Pegasus runs or flies away with his rider, the result is often disastrous to the latter. We have already given proof of Major Powell's great command over the realm of fiction. He will excuse us if we further illustrate his supremacy in this region by another equally striking quotation. Writing of the so-called palæolithic implements recently found in New Jersey and some other places in the Eastern States, he says:

"These implements were gathered in very great numbers and collected in various museums in the United States and many collections were sent abroad to the great museums of the world. Several different collectors were engaged in this enterprise for some years and acquired great reputation for their proof of the antiquity of man on this continent and for their zeal in discovering the evidence, and to recompense them for this work they were made members of many scientific societies throughout the world and decorated with ribbons, and some were knighted."

We took the liberty in our last paper of calling indirectly on Major Powell for exact details regarding the Nampa image, but without very great success. Will he allow us respectfully to ask for some further particulars concerning this very startling paragraph of his, in order to remove the suspicion that spontaneously but irresistibly lurks in our mind that it too is "based on error"? It would be deeply interesting to the archæologists of this country and of others to learn where are the "very great numbers" of these palæoliths from New Jersey, in what "museums of the United States" they are stored, and to what "foreign institutions

* The Glacial Nightmare and the Flood, p. 469.

many collections have been sent." We should also like to know how many of these collectors "have been made members of many scientific societies," how many have "been decorated with ribbons," and the color, style, and significance of these same ribbons. But especially would it delight the archæological world to be favored with a list of the Sir Knights who have received the accolade as a reward of their great powers and magnificent achievements on the hard-fought field of American archæology, and who are now Sir Somebody Something and Sir Something Somebody among their untitled scientific brethren of this democratic land. We are free to confess that in our seclusion in "Ohio" we had not heard of these decorations, and did not know that the palæolithic heretics had amassed so much evidence in favor of their great archetype in America, or that they had been so highly and so widely honored for their discoveries. We must infer, though we had not heard of the fact, that our palæolithic acquaintance, Dr. Abbott, is now Sir C. C. Abbott, of Trenton, N. J., and Bristol, Pa. We congratulate him. Others will no doubt be heard from in due time.

We sincerely trust that the Director of the United States Geological Survey has not been in this instance also drawing on his imagination and clothing the creations of his fancy with "local habitations and names." But if not, we must express the fear that he has been looking at the palæoliths and their finders through his most powerful multiplying glass.

We write the above criticisms not without regret. Major Powell's services to geology as the head of the United States Geological Survey have been great. Not even himself will claim that they have been faultless. But in entering the controversial field it is needful first to make quite sure of the facts and then to reason logically from them. In the former respect some of Major Powell's paragraphs are "based on error," as we have shown, and his deductions from them are consequently mere fallacies. If no stronger argument can be found, the case for which he has pleaded may almost as well be abandoned.

In the midst of so much that is open to criticism it is refreshing and pleasing to find Major Powell expressing a sentiment with which all geologists and other scientists should agree and with which we ourselves are in full accord. We thank him for so well wording what must be the rule of all concerned who appreciate the present position of the palæolithic discussion in this country. He writes:

"We will all withhold final judgment until the evidence is in, being perfectly willing to believe in Glacial man or Tertiary man or Cretaceous man if the evidence demands it, and being just as willing too to believe that man was introduced on this continent within the last two thousand years if the evidence demands it. What care we what the truth is if it is the truth?"

Grant this, and courtesy in debate, and the present controversy will not have been useless. E. W. Claypole.

Akron, Ohio, *June* 29, 1893.

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# EDITOR'S TABLE.

## *CIVIC DUTY.*

AMONG the hopeful signs of the times we may reckon the increased attention that is being given in our higher schools to the study of "civics," a term which includes the general principles of government, the Constitution of our own country in particular, and the duties of citizenship. It is somewhat extraordinary that the importance of instructing our youth in these subjects was not earlier recognized; but we may hope that, now that they have been introduced pretty generally into our educational courses, they will assume the prominence to which they are entitled. If the State undertakes to educate, it should be mainly and primarily with a view to producing good citizens; and the instruction which specially pertains to this object should in all public schools have an honored, if not indeed the foremost, place.

What is government? is a question which must spontaneously occur to the mind of every young person, and the teacher is fortunate who has a subject to deal with in regard to which his or her pupils are already prepared to ask questions. Government, it can be explained, in the first place is control. Control may be exercised either for good or for evil—either in excess of requirements, or in due proportion to

requirements, or in measure inadequate to requirements. Control exercised for evil is tyranny, and should, wherever possible, be resisted; control exercised for good is government in the best sense and deserves loyal acquiescence and support. Control in excess of requirements again is tyranny, even though exercised not by a monarch but by a majority of the citizens; control in due proportion to requirements is government in a good sense; control inadequate to requirements means a greater or less degree of anarchy. It should not be difficult to interest the minds of the young in deciding or trying to decide for themselves certain practical questions to which these definitions would naturally give rise. Take the government of a given country at a given time: was it tyrannical or was it reasonable government? Did it deserve resistance or support? Such and such laws, are they in excess of requirements, or are they such as circumstances demand? What are we to understand by "requirements"? Requirements for what? Here is the opportunity for pointing out how purely meddlesome and intrusive a great deal of legislation is—the mere mandates of majorities who want to have their way in everything, and are not content to win others over by persuasion, but insist on forcing them into conformity by legal measures. The "requirements" it can be shown, beyond which political control should not go, are the requirements of national cohesion. Whatever tends to enforce uniformity of practice or habit or opinion beyond the demands of national unity partakes of the nature of tyranny, whether the authority that imposes it has one head or a million heads. The necessity for government in the true sense can be made evident to the weakest understanding, and from this will obviously flow the duty of every citizen to aid in the maintenance of law and order. What kind of a society, it may be asked, would that be the sole foundations of which were force and fraud? What would become of human industry if the laborer could not depend on receiving his honest wages, or any worker on protection in carrying on his employment? Law, it will be seen, is no restraint upon the good, but is their shield against the aggressions of the evil; to the latter alone is it a terror, and they alone can have any interest in weakening its authority. Yet even they would suffer were there no law, and consequently the ideal condition of things for a bad man would be one in which others obeyed the law while he succeeded in evading it. The habitual criminal is thus no better than a beast of prey or a parasite.

Teaching of this nature addressed to a class in which some kind of public opinion was capable of being evoked would, we are persuaded, do much to create in the minds of the young a sense of the interest they have in upholding the institutions of the country, both national and municipal. We incline to the opinion that this interest should first be awakened by means of general considerations upon government before detailed instruction is given in the national Constitution. When the time has come for the latter, the different purposes which each power in the State is intended to serve should be carefully explained, and the pupils should be invited to exercise their own independent judgment upon the Constitution as a whole and upon its several parts. They might be freely asked whether they could suggest anything better, and the whole subject should be commended to them as one in which they have an interest that can not safely be neglected. It should be impressed upon them that, if honest people do not take an interest in politics, dishonest people are sure to do so, and that the only way to nullify the influence of the bad is for the good—those who have the welfare of their country at heart—to occupy the field in overwhelming numbers themselves.

Modern writers note a decline in the sentiment of patriotism; but we can afford to let the old patriotism go, if we can get a better patriotism in its place. The old patriotism involved hardly less of hostility and ill-will to other countries than of attachment to one's own. The new patriotism calls upon us to serve our own country first, and no less in peace than in war, but to be desirous that other countries should be equally well served by their sons. The old patriotism formed easy alliances with selfish and unworthy interests, so that the trade of patriot became one of the most suspected of vocations—so much so that the sturdy old Tory, Dr. Johnson, denounced it as "the last refuge of a scoundrel"; but the new patriotism which can not commend itself by loud-mouthed denunciation of other countries can only make itself known and felt by useful activity in the public interest at home.

The complete instruction of our youth in civics will have to embrace, we regret to say, a description of the principal evils which dog the steps of representative government. We have just glanced at the evil of indifference in political affairs, but in a course of instruction it would merit much fuller treatment. Then there is the opposite evil of excessive partisanship leading to the gravest abuses of administration, and through the frauds which it introduces into the working of the political machine threatening even the stability of the State. There is the evil of excessive taxation, resorted to in order that the party in power may have more money to distribute for political purposes. There is the evil of corrupt understanding between the party in power and business men whose pecuniary interests that party can promote by legislation—so much tariff (for example) meaning so much money to be contributed at election times. The celebrated letter in which the chairman of a certain committee threatened to "fry the fat" out of certain manufacturers who, after having been put in the way of enriching themselves at the expense of the public, had failed to respond with due liberality and gratitude when the hat was being passed round for a great political campaign, should be printed for an everlasting remembrance and illustration of "how it works." As regards the thieves and pirates who obtain government contracts and enrich themselves by furnishing inferior articles, it would be easy to rouse against them the fierce indignation and reprobation of any class of ingenuous youths; and it would not be hard to show that many other frauds upon the Government, such as charging undue prices for things, obtaining by collusion contracts at figures beyond what would afford a fair profit, and so on, are all of an infamous nature and utterly unworthy of any man pretending to be a good citizen. Great care should be taken not to deal with any of these subjects in a cynical spirit or to create the impression that the evils indicated are more widespread than they really are. It ought to be a paramount object to promote respect for the country in which we live, and while the evils and dangers which beset our system of government should be plainly pointed out, stress should also be laid upon the vast amount of faithful service and unselfish devotion which the country receives from its worthier sons. The spirit to cultivate is not one of despondency, but one of hope, of confidence, and of resolute endeavor. Let our young people but have the right kind of teaching, and they will respond to it, and in less than ten years the effect for good upon the public opinion and public life of the country will be very apparent.

# LITERARY NOTICES.

Vertebrate Embryology. A Text-book for Students and Practitioners. By A. Milnes Marshall, M. D., D. Sc., Professor in the Victoria University, etc. New York: G. P. Putnam's Sons. London: Smith, Elder & Co., 1893. Price, $6.

As the author truly states in his preface, most of the text-books of embryology aim rather at explaining the general progress of development within the several animal groups than at supplying complete descriptions of individual examples. Thus there have been no reasonably complete accounts of the development of the common frog or of the rabbit, while in human embryology so much is yet unknown that the descriptions and figures given in illustration of them are those of embryonic rabbits, pigs, chickens, or dogfish. As the results of recent investigations have shown that marked differences, both in the earlier and the later stages of development, may occur between allied genera and species, it may be perceived that this practice of illustrating human embryology by embryological types selected from the lower animals may be the cause of much confusion.

In preparing this volume the author has selected a few types to each of which a separate chapter is devoted. The first chapter gives a general account of the development of animals, including the structure, maturation, and fertilization of the egg, and a description of the early stages of the development of the embryo. We think the author has made a slight *lapsus calami* in the statement on page 13 that "after one spermatozoon has entered an egg others seem incapable of making their way in"; we judge that he intended to write "yolk" instead of egg, for spermatozoa have been found not only in the zona but in the perivitelline space. We believe that it is after the spermatozoon gains entrance into the yolk instead of the egg, as is stated, that the tail is lost. The theory of sex is too meagerly presented to afford the student any enlightenment, none of the more important theories being mentioned.

The second chapter is devoted to the amphioxus, giving a general account of the early and late embryonic development of this fish-like animal. In this chapter the author has followed the descriptions of Kowalevsky, Hatschek, Lankester, and Willey; and this animal has been selected as an introduction to vertebrate embryology because of the simplicity of its earlier developmental history as well as on account of the clew that this affords to the more complicated conditions occurring in the higher vertebrates.

The third chapter gives a general account of the development of the frog, the description of the processes of maturation and fertilization of the egg being based on O. Schultze's investigations, while the account of the early stages of development of the nervous, circulatory, digestive, and reproductive organs is based on the observations of the author and his pupils.

The fourth chapter gives a description of the development of the chick that is so familiar from the accounts given in most of the physiologies.

The fifth chapter gives an account of the development of the rabbit, the author following the accounts of Van Beneden, Kölliker, and Duval in his description of the processes of segmentation of the egg, of the formation of the blastodermic vesicle, and of the placenta. The descriptions of the later stages of development are based on his own observations.

The sixth and final chapter describes the development of the human embryo, and is, of course, to a large extent, based on the researches of His.

The author requests that human embryos of any age, but more particularly those of the first month or six weeks, be wrapped in cotton, placed in a bottle of strong alcohol, and sent to him at Owens College.

We note, especially in the earlier part of the book, a duplication of illustrations: thus Figures 1 and 45; 2 and 14; 3 and 46, 47, 48, 49, and 50; 4 and 97; 5 and 102; 6 and 103; 7 and 105; 8 and 25; and 9 and 26, are identical.

The book is clearly written in English rather than Anglicized German, and there is a most agreeable omission of German terms that mar the harmony of some of the recent works on embryology. Long quotations and discussions of mooted points are avoided, the author apparently seeking to present that

that will facilitate the work of the student. We believe that the volume will become a popular text-book on the subject.

A History of Crustacea. Recent Malacostraca. By Rev. Thomas R. R. Stebbing, M. A. With Numerous Illustrations. New York: D. Appleton & Co., 1893. Pp. 466. Price, $2. Being No. 71 of the International Scientific Series.

In the preface to this work the author says that his ambition was to prepare a volume "to which beginners in the subject will have recourse, and one which experienced observers may willingly keep at hand for refreshment of the memory and ready reference." He has succeeded eminently well in carrying out that project; for, besides giving the classification, physiology, habits, and description of some thousands of crustacea, Mr. Stebbing has added several new species to the already voluminous list of crustaceans, and made interesting reading of what students and beginners so often find dreary and unentertaining.

The chapter entitled "Specimens" contains some very useful information on the collection of crustacea for examination, and the author rather humorously points out that even at the breakfast table examples of three very distinct orders can be obtained "in a dishful of prawns." In the same chapter he explains the best methods of capturing crustacea, and tells of some new genera which are found at the enormous depth of three thousand and fifty feet.

The chapters on the various tribes, legions, and families of the suborders *Macrura* and *Brachyura*, which contain among them the edible crab, lobster, shrimp, etc., are full of interesting and valuable information, and the author has in many instances corrected the errors of former natural historians who named certain members of the smaller crustaceans before they had properly developed from the larval stage. Mr. Stebbing also bemoans "the hard fate of natural historians," particularly beginners, for he says that the confusion of names would sometimes deter a timid person from pursuing the study. He believes in the simplest possible nomenclature, and he has himself endeavored to simplify his work by making it easily understood by those who are inexperienced. The chapters on the habits of the cocoanut crab (*Birgos*) and of the various kinds of land crabs will be read with very great interest by all classes of people, apart from those who are engaged in the study of the crustacea. As a matter of fact, the entertaining manner in which the author tells of the curious habits of these most curious animals, of their strangely developed instincts, and of their general modes of living, makes more interesting reading than is generally found in such exhaustive scientific works.

The vexed question of the position and existence of eyes in some of the crustaceans is finally set at rest in this work. Mr. Stebbing also proves beyond question that the crab uses the bases of his walking legs as mandibles—a fact which has heretofore been accepted only in theory by a few scientists. In describing the latter peculiarity of the edible and other species of crab, the author humorously remarks that, although it may seem as strange for a crab to use his feet for the purpose of mastication as it would be for a human being to have his teeth upon his elbow for a similar purpose, it is nevertheless a fact indisputably proved. Over three thousand species of crustaceans are defined in this volume, which can not fail to interest the general reader, as well as being of much importance to the student and as a book of reference.

Electricity and Magnetism. By Edwin J. Houston. Pp. 306.—Electrical Measurements. By Edwin J. Houston. Pp. 429. Price, $1. New York: The W. J. Johnston Co., 1893.

There are already so many elementary books on electrical subjects, addressed either to the student or the general public, that a new book must needs have distinctive merit to justify its publication. This is possessed in an eminent degree by the above collection of primers from the pen of Prof. Houston. He has the gift of lucid exposition, and is, moreover, thoroughly familiar with his subject. Not the least of the merit of his exposition is his interpretation of the phenomena in the light of more recent electric theory, which has undergone marked changes in the past few years. Each book consists of a collection of chapters complete in itself, which the author terms a primer, the closing chapter being a brief review of all the oth-

ers, and termed a primer of primers. A feature of the work is the appending to each primer of one or more extracts from current electrical works on the subject matter of the primer.

In electricity and magnetism the author deals with the sources and phenomena of static and current electricity and magnetism. His statement of the theories of magnetism is a particularly clear and concise summing up of the present views of the subject, and it is to be regretted that he did not undertake to do the same with the theories of the electric current. In the primer on atmospheric electricity our quite limited knowledge of the subject is presented concisely, though it is to be noted that the author follows the accepted views of lightning protection, and gives no hint of the recent important experiments and theories of Prof. Lodge on this subject.

The second of the books takes its name from the first three primers, which are devoted to the measurement of electric currents, electro-motive force and resistance, and are concerned with an account of how these measurements are made.

The voltaic cell forms the subject of one primer, and thermo-electric batteries of another. The distribution of electricity by continuous currents and the arc and the incandescent light are considered in three primers. In the primer devoted to the alternating current a brief account is given of the modern theory of such a current; and in a primer on alternating currents of high frequency there is an excellent summary of the remarkable experiments of Tesla with such currents. A primer is devoted to induction coils and transformers, one to dynamos, another to the electric motor, and another to the electric transmission of power. Other primers are on electro-dynamics, electro-dynamic induction, and alternating current distribution. The books are printed on good paper, in clear type, and are of convenient size.

Original Papers on Dynamo Machinery and Allied Subjects. By John Hopkinson, F. R. S. New York: The W. J. Johnston Co., 1893. Pp. 249. Price, $4.

The researches of Dr. Hopkinson on electro-technical subjects, more especially those upon the dynamo, have long been recognized as of the highest importance, both for their theoretical interest and for their value in the bearing they have upon the work of the practical constructor. The papers in which these researches have been described have heretofore been accessible only in the proceedings of scientific societies and in the technical journals, and are now for the first time collected in the present volume. The collection consists of eleven papers, five of which are devoted to the dynamo, in which are developed the theory and use of what has come to be known as the "characteristic curve of the dynamo." This curve expresses the relation between the current and electro-motive force of a dynamo at a given speed—the horizontal distances or abscissas representing the amount of current, and the ordinates the electro-motive forces—and in the hands of Dr. Hopkinson has been found capable of giving a solution to all the complicated questions of practical dynamo construction. Other papers are: Some Points in Electric Lighting, the Theory of Alternating Currents, the Theory of the Alternate-Current Dynamos, and a report upon the Westinghouse transformers. In the first of these a very interesting mechanical illustration is given of the facts of electrical induction by means of a model, first suggested by the late Prof. Clerk Maxwell, and in the second the proper method of coupling up alternating dynamos in a supply circuit is pointed out, and the conditions for the most efficient action determined. Alike to the student and the practical dynamo designer these papers will prove of the greatest value, and will form a desirable if not essential addition to his technical library.

Idle Days in Patagonia. By W. H. Hudson. New York: D. Appleton & Co. Pp. 256. Price, $4.

The author of The Naturalist in La Plata gives us in this volume some further account of his wanderings in South America. He calls himself an "idler" here, being made such by an accidental pistol-shot which kept him for some time from active exploration. Yet, though unable to go far afield, Mr. Hudson gathered many curious observations and much store of entertaining anecdote during his idle days. The reader will learn from these chapters that Patagonia is not

wholly a wild, inhospitable tract, inhabited by wandering savages, but that the northern part, at least, is a grazing country, with settlements and white inhabitants, much like the adjoining districts of the Argentine Republic. He will learn also something about the natural products of the land, its climate, life among the settlers, the Indians, the wild animals, and most of all, for the author is an ornithologist, about the birds. In the cultivated valley of the Rio Negro there are birds in plenty—mocking-birds, several varieties of finches, wood-hewers, swallows, and among larger fowls the upland geese, owls, vultures, condors, ostriches, swans, and flamingoes. Mr. Hudson does not write like a teacher nor like a restless searcher after discoveries, but rather like one telling of a pleasant vacation; hence it is safe to predict for him many delighted readers. The book has been fully and pleasingly illustrated by Alfred Hartley and J. Smit.

Evolution and Man's Place in Nature. By Henry Calderwood, LL. D., F. R. S. E., Professor of Moral Philosophy, University of Edinburgh. New York and London: Macmillan & Co., 1893. Pp. 349. Price, $2.

In the opening chapter of this work Prof. Calderwood says that "the general acceptance of Darwin's theory of evolution gives force to the demand for discussion of this problem." The author uses the sentence just quoted as a reason for writing the book. He accentuates that sentence by stating, on page 2, that "whatever limitations are to be assigned to the theory, we must at least grant that a law of evolution has had continual application in the world's history"; and he adds that in the matter of elucidating the phenomena "the researches of Charles Darwin and Alfred Russel Wallace have led the way."

It is not easy to understand how such a man as Prof. Calderwood could have fallen into the too common error of attributing priority to Darwin in connection with the doctrine of evolution. Herbert Spencer published his essay on the Development Hypothesis in 1852; in 1855 the Principles of Psychology, an application of the doctrine of evolution to mental phenomena, followed from the same pen; and, finally, in 1857, or two years before the appearance of Darwin's Origin of Species, Mr. Spencer published Progress: its Law and Causes, which was devoted to the discussion of *universal evolution*.

Nevertheless, Prof. Calderwood's work is an ably argued treatise on the subject, and oddly enough, in the chapters on Sensory and Rational Discrimination and Rational Life, he quotes from the earlier works of Mr. Spencer to substantiate his own attempted refutation of the Darwinian theory. At the outset he asks, "How has he (man) found his place on the summit of existence, and what has he done since coming to his heritage?" Then follows a chapter on the characteristics of human life, in which the contrasts between organic and rational life are treated; the author asserting that intelligence alone makes man the master in Nature; that in human activity "dualism of function is complete"—i. e., both rational and organic life—whereas "evidence fails when we look for independent action of intelligence in animals." And he continues: "We do not find that any of them" (animals) "in their natural state rise above interpretation of signs."

The chapter on Sensory and Rational Discrimination presents forcible argument demonstrative of this duality of function culminating in man's possession of rational power, by virtue of which "every member of the race goes forth on his way as a free man, taking possession of his inheritance in the earth. For every man who does not lose his way in darkness or through blinding passion . . . a rich possession is waiting, quite above supply of the common requirements of organic life. Science is his servant, literature is his property, philosophy is his guide in higher thought, revelation becomes his inspiration. Under warrant of abundant evidence, we distinguish two worlds in Nature—the world of matter and the world of mind; a world visible to the eye, a world invisible to organism—visible only to rational insight. . . . Thinkers of quite opposite schools are agreed that there is no possible science of Nature which does not distinguish between the material and the spiritual, between that which is known by sense and that which is known in consciousness. Nature's testimony admits of no doubt as to the reality of these separate spheres."

The chapter on Animal and Rational Intelligence is a searching examination of the difference between the two kinds, or rather three kinds, for a distinction is made between the intelligence of the higher and that of lower animals. A weakness is found in the argument for evolution of mind; for to prove it "we must open a road from sensory impressions to ideas of objects, and from these to general abstract ideas, and this must be such a road as the higher mammals could find for themselves before man's appearance on the earth. Here is the essential test of an all-embracing scheme of evolution; to account for interpretation of sensory experience . . . this problem separates us from much that has been already assured in natural history, strongly favoring evolution." The argument, as to man, is continued in the chapter on Rational Life, where the science of mind is found to outstretch the science of biology, and man's life to be superior to all animal life, possessing powers which are not shared by the animals; having possibilities and a destiny peculiar to himself, impossible to organic life, even to the organism which is part of his own being. This conclusion as to the inability of biology to present a science of human life "is reached by all that biology has to offer by way of explanation." All that has been demonstrated as to the action of the nerve system and of the brain is accepted and turned to full use, but it "carries no explanation of the activities of the rational life."

The lines of investigation pursued do not include any examination of Christianity as a supernatural religion, but only as a spiritual force contributing to the advance of the race, certain of the characteristics of which "have wielded a mighty influence in the course of the ages."

Summing up his investigations of the theories of Darwin, Wallace, and their followers, the author claims that the origin of man is completely severed from the scheme of organic evolution. "Man has his place in a physical system within which all is subject to decay and death; he has his place in a spiritual system, within which is no trace of death, but promise of continuity beyond the present state. Evolution has turned attention on different phases of the origin of existence on the earth. It helps us better to see how varied these origins have been." But it is insufficient to account for life itself. It stands "before us an impressive reality in the history of Nature. But this evolution is only a limited cycle, within the greater cycle of Being and its history," and all leads to the conclusion that "there is a power operating continually in Nature, which does not come within range of the observation possible to scientific modes and appliances, yet to which science is ever indirectly bearing witness."

The Political Value of History. By W. E. H. Lecky, LL. D., D. C. L. New York: D. Appleton & Co. Pp. 57. Price, 75 cents.

This is a reprint of a lecture delivered before the Birmingham and Midland Institute, of which the author is president. The words of such a man as Mr. Lecky, on the value of history as a precedent for guiding political policy to-day, can not fail to be of value. The question is one which has by no means always been answered affirmatively, and one which in recent times has been much argued.

Mr. Lecky first shows how history arose and what was its original function, and then briefly traces its development as a science down to the present century. That he has taken a judicial attitude is shown by the following passage: "Nor will any wise man judge the merits of existing institutions solely on historic grounds. Do not persuade yourself that any institution, however great may be its antiquity, however transcendent may have been its uses in a remote past, can permanently justify its existence, unless it can be shown to exercise a really beneficial influence over our own society and our age. It is equally true that no institution which is exercising such a beneficial influence should be condemned because it can be shown from history that under other conditions and in other times its influence was rather for evil than for good." He dwells on the necessity for understanding the "dominant idea or characteristic of the period" which the student is investigating; "what forces chiefly ruled it, what forces were then rising into a dangerous ascendency, and what forces were on the decline." He speaks of the im-

portance of the history of institutions, their changes to meet new wants, and their inevitable fall, although, perhaps, by a process of slow decay, upon failure to adapt themselves to new requirements. He says: "There is probably no better test of the political genius of a nation than the power which it possesses of adapting old institutions to new wants." Next he considers the value of a study of the great revolutions, discussing the two theories extant as to their causes and possible avoidance. "My own view of this question," he says, "is that although there are certain streams of tendency, though there is a certain steady and orderly evolution that it is impossible in the long run to resist, yet individual action and even mere accident have borne a very great part in modifying the direction of history." Having characterized history as one of the best schools for that kind of reasoning which is most useful in practical life, teaching men to weigh conflicting probabilities, to estimate degrees of evidence, to form a sound judgment of the value of authorities, Mr. Lecky concludes by observing that its most precious lessons are moral ones. It expands the range of our vision and teaches us, in judging the true interests of nations, to look beyond the immediate future. A perusal of this little book will well repay the general reader and be especially valuable to those engaged in the study or teaching of history.

The Interpretation of Nature. By Nathaniel S. Shaler, Professor of Geology in Harvard University. Boston and New York: Houghton, Mifflin & Co. Pp. 305. Price, $1.25.

However widely apart the theologian and naturalist may be at the present moment, the time is not far distant, according to Prof. Shaler, when they may stand upon common ground. In the next century science may even people the unknown with powers justly inferred from their manifestations. There will be no longer a natural and a supernatural realm, but one universe "through which the spirit of man ranges with ever-increasing freedom."

We may trace the evolution of scientific inquiry to the germ of curiosity evinced by the lower animals. The early races of men attributed the control of Nature to spirits like themselves. These were gradually endowed with greater powers until the idea of a hierarchy of gods was reached, and among the more intellectual nations this culminated in monotheism. Theologic explanations, however, could not satisfy the interrogative impulse possessed by the Aryan race, and especially by the Greeks. The want of scientific interest shown by the Romans is ascribed by the author to a different racial inheritance, and the long period of unquestioning quiet is not charged to the soporific influence of Church authority so much as to a religious bent derived from Semitic ancestors. With the revival of learning came the resurrection of inquiry, and to the system of Aristotle the moderns added the method of verification by experiment.

The naturalist is generally too apt to look upon the course of Nature as invariable, since he knows that any physical state is the resultant of previous conditions, and that the quantities of force and matter are unalterable. There are, however, phenomena which can not be predicted, the outcome of revolutionary changes that transcend experience. The crises at which these occur are termed critical points, and are typified by the point at which an orbit passes from the parabolic to the hyperbolic form. Similar results follow alterations in temperature and the manifestation of latent inheritances.

In considering the march of the generations it is seen that the psychic progress of man is unparalleled by anything in the evolution of species. The generations are also bound together by vast stores of experience and knowledge, which the human race accumulates and transmits in various ways to the young, so that great advance is made possible.

Man owes his moral development to the exercise of altruistic motives—sympathy with his kind, with animals, with God and Nature. We can follow these to lowly beginnings, but can not account for their growth by any theory of selection. The determinative influences are hidden, "unless we assume a law of moral advance."

As to the immortality of the soul, "it is easier to suppose that an individual mind can be perpetuated after death in a natural manner than to explain the phenomena of inheritance." The naturalist thus finds that, in

order to interpret the latent powers of a molecule, or the transmission of organic tendencies, he must assume the intangible, and endow matter with a sort of soul. He also derives from his study of Nature motives that are moral and a confidence akin to faith. This is close upon religious territory, and the preacher may utilize it.

The substance of this volume was first presented in lecture form at Andover. It is suggestive, and teaches a form of monism, though scarcely such as Prof. Haeckel would indorse.

Horticulture. Ten Lectures delivered for the Surrey County Council. By J. Wright, F. R. H. S. With Thirty-seven Illustrations. Pp. 154. New York: Macmillan & Co. Price, 35 cents.

This "Primer of Horticulture" is designed as an introduction to a scientific and practical study of gardening and fruit-growing, either for the small householder, who enjoys the care of his seven-by-nine piece of ground, or for the farmer to whom the best and most economical methods are matters of "dollars and cents."

The first lecture is devoted to the question of land allotments, with which we in the United States are not concerned. The second lecture is headed The Soil, its Nature, Preparation, and Improvement. This chapter contains in clear and concise language matter of the first importance to every farmer—matter, in fact, without which the tiller of the soil is as much handicapped as was the compassless mariner—matter usually, however, locked up in large, expensive, and technical works, and therefore not at the command of the working farmer. Lecture III is devoted to the raising of "crops, plants, and trees," and includes, among many other important matters, a history of the seed from its formation to the development into a new plant; a description of the various methods of grafting, and the why and wherefore of fertilization. Lecture IV treats of the Food of Crops—Manuring the Soil, and, like Lecture II, is full of practical instruction. The Enemies of Crops and Trees, in the shape of weeds, birds, insects, fungi, etc., are next considered. Lecture VI deals with the very important part of the farmer's work—planting. In Lectures VII and VIII what are the most profitable crops is the question answered. Lecture IX considers the Preservation and Disposal of Garden Produce, including Flowers and Fruit; and Lecture X closes the book with a talk on the desirability of exhibitions and fairs and the necessity for high ideals in gardening. The construction of the work is admirable, and it might be read with profit by many scientific men as a model for popular scientific exposition. Great care has been taken to select the most important aspects of the topic discussed, the essential facts being presented in clear and untechnical language, while the subject is not overburdened with detail.

How to know the Wild Flowers. By Mrs. William Starr Dana. New York: Charles Scribner's Sons. Pp. 298. Price, $1.50.

This title will attract the attention of lovers of Nature, especially if they are able to spend the summer months in the country. An acquaintance with natural history, even if it be slight, unquestionably adds very much to the pleasure of out-of-door life, rendering interesting, localities which but for their animal and vegetable forms would be quite the reverse, and making doubly pleasurable a sojourn in a region where scenic beauties are also present. The author's purpose has been to give the reader a "bowing acquaintance with the common wild flowers of our woods and fields"; but, while the attempt is well meant, we can not say that it is a success. There are descriptions of most of the common wild flowers of the Middle States, with the exception of "flowers so common as to be generally recognized," "flowers so inconspicuous as generally to escape notice," and "rare flowers and escapes from gardens." But the descriptions, particularly of essential parts, resemble those in Gray's Manual, and are too short and technical for the uninstructed observer. What remains is more of a literary than a scientific character, there being considerable poetry and more or less sentimental comment. The illustrations, of which there are one hundred and four, are not at all satisfactory as an aid in identification, the purpose for which they are intended. A classification based on colors is introduced which is necessarily of little value, as the

colors of flowers shade off so imperceptibly into one another, and are at the same time so variegated and inconstant, that they are likely to mislead even the trained observer.

The book will do good, however, if it incites to the study of a department of Nature which more than any other is calculated to stimulate the powers of observation.

The Silver Situation in the United States. By F. W. Taussig, Ph. D., Professor of Political Economy in Harvard University. New York and London: G. P. Putnam's Sons, 1893. Pp. 133. Price, 75 cents.

This work is divided into two parts. The first discusses the history of the "silver legislation" and the economic conditions which have been brought about by the adoption of a silver currency in 1878. The second portion of the book considers the arguments in favor of a silver standard. In the chapters under the general title, The Economic Situation, Prof. Taussig closely analyzes the movements of gold and silver during the last fourteen years. He does not believe that the gold reserve of $100,000,000, fixed as the minimum by Congress, can very measurably be increased, and he attributes the decrease in the amount of gold held by the Treasury—from $190,000,000 in 1890 to $108,000,000 at the beginning of the present year—to the fact that "the great sums due the United States by foreign countries" are not paid for by the return of gold, but by "the transmission of American securities held by foreign investors and sent by them for sale in the United States." He claims that the Treasury estimate of the stock of gold in the United States is many millions of dollars "in excess of the actual stock." Having summarized the arguments in favor of silver, quoting the very words of those who present them, "as compared with commodities silver has been more steady in value than gold," and that, "so far as the attainment of the closest possible approach to the ideal justice is concerned, a silver standard would have served the purpose better than a gold one"—the author offers as a simple answer to them the facts he has recited in his preceding pages, and says that the silver men "have not made out their case against the existing order of things. There are no serious evils due to an insufficient supply of money." These and other negative reasons apply to the arguments of those who favor international bimetallism and of those who favor the independent use of silver by the United States. When we consider the importance not only of stability in the medium of exchange, but of general confidence in that stability, these and other negative names which are mentioned ought to suffice for rejecting the proposals of the silver advocates. But there are positive reasons in addition. The eventual effect of a silver standard must be to cause a rise in prices—not immediate, but certain. This, while the present tendency to falling in prices, with stationary or rising incomes, work no hardships to debtors, would be fraught with real and serious inconveniences to creditors. Other positive reasons lie in the conditions of the production and use of silver at the present time, which are increasing with extraordinary rapidity. Another objection to a change to a silver standard is the immorality of the disposition to tamper with the currency as a remedy for real or fancied evils. Gold, on the other hand, performs the functions of a measure of value and a standard of value with as close an approach to perfection as there is any reasonable ground for expecting from any monetary system. For these reasons the schemes proposed for a tabular or multiple standard of value do not seem called for by any serious exigency not met by the gold standard. The book contains some useful comparative statistics and a comprehensive chart of fluctuations in gold and silver.

Telephone Lines and their Properties. By Prof. W. J. Hopkins. New York: Longmans, Green & Co., 1893. Pp. 258. Price, $1.50.

This is a work which has for its object a more complete account than has yet been given of the telephone line, not only its mechanical construction, but its electrical properties, and the way telephonic transmission is affected by telegraphic and other electric currents. The range of subjects comprise a brief account of overhead construction in city lines, and a somewhat full one of underground work, in which the relative advantages and disadvantages of various kinds of

conduits are considered. Long-distance lines, the various kinds of wire suitable for telephone use, insulators, and the exchange system are among the subjects treated of in the part of the book devoted to the mechanical construction of telephone lines. A chapter upon the propagation of energy, in which a brief account is given of the modern view of electric currents, precedes the consideration of the electrical properties of the telephone line. Among the subjects discussed in this portion of the work are self-induction, interference from outside sources—such as air and earth currents—telegraphic induction and induction from electric lighting and railway circuits, properties of metallic circuits and of cables. The work is written for the practical telephone constructor and for students, and will doubtless prove a valuable work of reference.

How to manage the Dynamo. By S. R. Bottone. New York and London: Macmillan & Co., 1893. Pp. 63. Price, 60 cents.

This little manual is addressed to those who have the care of dynamos, and is clearly and directly written and free from all technicalities. Instructions are given as to properly setting the machine so as to avoid vibration, and the different parts—the field magnets, armature, and commutator—are briefly described, and instruction given for their proper care. Simple methods of determining and locating leaks are also given. The book closes with a list of the chief electrical terms, and is provided with an index.

The Transmitted Word. By W. J. Keenan and James Riley. Boston: Dorchester Printing Co., 1893. Pp. 113. Price, 75 cents.

The authors of this essay state its purpose in the preface as follows:

"To know somewhat of the application of this great force, which man has discovered and called electricity, these pages are written. They are free of all technical terms. Simplicity has been the constant aim. The student's text-book on electricity has been written. The public's book has not been written. And, as we are taught to know ourselves, so should we know the forces that surround us. Especially so if we use these forces. Every subscriber of the telephone should know the rudiments of its action. This is why this book is put forward. It is intended as a primer in telephonic and other kindred instruction. . . ."

This purpose of the authors is laudable enough, and, if it had been adhered to, they might possibly have produced a useful book. Their real aim seems, however, to have been to give an exhibition of what they probably regard as fine writing, using the telephone as an excuse for their literary effort. The book is written throughout in the most approved style of sophomoric composition, and contains very little real information about the telephone. The reader who had no previous knowledge of the subject would have a hard time indeed in trying to get any clear ideas of the Blake transmitter or induction from the description of the authors. The book has, however, one great merit. It is short.

Man and the State. Lectures and Discussions before the Brooklyn Ethical Association. New York: D. Appleton & Co. 1892. Pp. 558. Price, $2.

This volume of lectures and addresses before the Brooklyn Ethical Society is devoted especially to subjects of current political discussion, such as the tariff, the monetary question, the negro problem, the government of cities, and kindred subjects. To those who are familiar with the discussions before the society, or who have become acquainted with the character of the work from its previous publications, no word of commendation of the quality of these papers is necessary. The addresses are thoughtful and serious discussions of current political and economic questions, and can not fail to be welcomed by all who take an intelligent interest in public affairs. It would be impracticable to attempt to give here either a *résumé* or criticism of the dozen and a half addresses which compose the volume, though some features of interest may be briefly indicated. The volume was published last year, previous to the presidential election, and the addresses were selected chiefly with reference to the questions before the country during the campaign. We have therefore a discussion of the tariff from the side of both protection and free trade, a plea for sound money, and a defense of each of the great political parties. The free-

trade side of the tariff question is presented by Mr. Thomas G. Shearman, and calls for no special comment, as he presents only the well-known considerations in favor of industrial freedom. His opponent, Prof. Gunton, however, attempts to defend protection on philosophic grounds and erect it into a permanent system instead of leaving it in the position of a temporary expedient, applicable only to the infancy of industries. He regards protection a means of maintaining the wage level of a country, by forcing a competing country to pay in duties an amount which will put it on the same basis as the country of higher wages. The tariff can in justice therefore be only sufficient to cover the difference in wages of the competing countries—a condition, it need hardly be said, that would not suit our tariff beneficiaries at all. Dr. Lewis G. Janes contributes a thoughtful paper upon the problem of city government, which is concerned mainly with pointing out the difficulties of the problem rather than with suggestions as to the solution. He insists, however, that the proper form of city government must be a matter of growth, shaped and determined by our political life, and that the example of foreign cities can be of but little use in helping us to solve the problem of American city government. Other essays of interest are Mr. John A. Taylor's defense of the independent in politics, Prof. Le Conte's discussion of the race problem in the South, the monetary problem by William Potts, and representative government by Edwin D. Mead.

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## POPULAR MISCELLANY.

**Explosion of Kitchen Boilers.**—The most common cause of the explosion of kitchen-range boilers is frost. If the pipes are frozen so that the steam raised by the fire can not escape, the danger of an explosion is very great. This should be prevented, where there is a liability of the pipes being frozen, by protecting the pipes and apparatus generally from the effects of frost. Protection may be given by covering the pipes with hair felt. Some boilers are in danger of explosion from the failure of water supply; but in the modern system of cylinder the hot-water tank is not entirely emptied, and a sufficient supply of water is usually left to carry the fire several hours. Boilers in districts where the water is "hard" may fail in consequence of the accumulation of an incrusted deposit within them and the pipes, whereby the pipes may be in time stopped up. The pipes, however, usually give warning of this danger long defore it becomes imminent, in the shape of violent noises and vibrations proceeding from the apparatus, which become unendurable and have to be removed before the explosion takes place. Finally, a safety-valve is a sovereign preventive of explosions from whatever cause.

**The Australasian Association.**—The next meeting of the Australasian Association for the Advancement of Science will be held in Adelaide, South Australia, beginning September 25th. The meeting will be presided over by Prof. Ralph Tate, of the University of Adelaide. The presidents of sections will be: Astronomy, Mathematics, and Physics—H. C. Russell, Government Astronomer of New South Wales; Chemistry—C. N. Hake, of Victoria; Geology and Mineralogy—Sir James Hector, Director of the Geological

Survey of New Zealand; Biology—C. W. De Vis, of Brisbane; Geography—A. C. MacDonald, of Victoria; Ethnology and Anthropology—Rev. S. Ella, of New South Wales; Economic Science and Agriculture—H. C. L. Anderson, of New South Wales; Engineering and Architecture—J. R. Scott, of Canterbury, New Zealand; Sanitary Science and Hygiene—A. Mault, of Tasmania; Mental Science and Education—Henry Laurie, of the University of Melbourne. The association has been in existence since 1888. The four previous meetings have been held at Sydney, Melbourne, Christchurch, and Hobart. The association has grown steadily since its beginning and now numbers about nine hundred members. The season of the meeting—when spring is passing into summer—is recommended as being one of the most favorable to visit South Australia, and particularly attractive to naturalists.

**Derelicts on the Ocean.**—We gave several months ago an account of the wanderings of the derelict schooner W. L. White, which, after having been abandoned not far from New York in the great blizzard of March, 1888, went ashore ten months afterward near the Hebrides, after having drifted five thousand miles back and forth on the Atlantic Ocean. The history of several other vessels pursuing a similar career may be found in the bulletins of our Hydrographic Office. The schooner Twenty-one Friends, abandoned in March, 1885, one hundred and sixty miles from Chesapeake Bay, drifted two thousand miles in four months, and was seen near Cape Finisterre at the end of eight months. The Ethel M. Davis drifted four thousand four hundred miles in three hundred and seventy days, and the David W. Hunt four thousand eight hundred miles in three hundred and forty-seven days, during which she was seen by forty-one passing ships. According to the United States Wreck Chart of the North Atlantic, there were forty-five derelict vessels in that ocean, and more than half of them were in the route of the transatlantic line steamers. These waifs are very dangerous, for their positions and courses are unknown, they are under no control, and may appear at any unexpected moment, at night or in a fog, or in storms, to crash into and sink whatever vessels they may meet. Possibly some of the steamers that have been lost and left no record have gone down after meeting with them.

**Indo-China.**—The whole region of Indo-China, as the Hon. G. N. Curzon, M. P., pointed out in a lecture before the Royal Geographical Society, is dominated by its great rivers, and may be divided into the mountain districts of the north, cleft by vast gorges; and the low plains of the south, mainly composed of alluvial deposits, where the coast lands are steadily encroaching on the sea. In the seventh century, Tongking, now sixty miles inland, was on the coast. A very remarkable feature, which gives parts of the coast a beauty comparable with that of the Inland Sea of Japan, is a broken belt of limestone cut into curious, flat-topped sections of all sizes, and perforated by the sea or rivers with many fantastic caves and tunnels. The masses of caverned rock rise to a height of from fifty to five hundred feet, and are best seen in the Bay of Along in Tongking. In Annam Mr. Curzon traveled to Hué by the "Mandarin's Road," a track which is carried over several *cols* by some skillful engineering in the form of rock staircases. Hué is a city of great interest, is beautifully situated, and is near a number of magnificent ancient tombs.

**Mongol Waterworks.**—The city of Aurungabad, India, is supplied with water by a system constructed three hundred years ago by Malik Umber, the Viceroy of Shah Jehan. Though the water came regularly, no one in recent times had determined the source of the supply. All that was known was that the water came from the stone image of a bull situated seventy feet above the level of the town, while further search was defeated by the superstition of the natives. The matter has been recently investigated by Mr. Beveridge, an engineer in the service of the Nizam, who found that the Gya Mookh, as it was called, was supplied by a pipe and a covered channel. This channel was traced up for a considerable distance, but the work was suspended on account of unhealthy emanations and the difficulties interposed by superstition. It was resumed by another engineer, Mr. Massett, who found that the channel crossed the Ursool River by a si-

phon made of cut stone pipes, and ended a short distance thence in a large infiltration gallery, the roof of which is arched over with brick, supported by the natural sides of the excavation formed of trap rock. This gallery, which is 9,460 feet long, is twelve feet below the bed of the river, and evidently obtains its supply from subterranean stores from the subsoil rock on its way to its natural outlet, the river. The position of the gallery has been chosen with great astuteness, which shows that the engineer of Malik Umber knew exactly what he was about. Behind it stretch hills surrounded by table land, having an area of twenty miles, with a configuration that would argue that the collecting area of the gallery must be at least twelve square miles. The hills contract in the direction of the river, till a semicircular valley is formed bounded by the river Ursool. The gallery has been so placed between the river and the hills as to form the chord to the arc. The works are now dilapidated, and do not furnish one third of the supply of water for which they are calculated.

**Hygienic Value of the Bicycle.**—The bicycle is highly commended as a hygienic instrument in a paper by Dr. Seneca Egbert on that vehicle "in its relation to the physician"—the relation, according to the author, being apparently one of keeping the doctor away. "In the first place," he says, "as an exercise cycling is superior to most if not all others at our command. It takes one into the outdoor air; is entirely under control; can be made as gentle or as vigorous as one desires; is active and not passive; takes the rider out of himself and the thoughts and cares of his daily work; develops his will, his attention, courage, and independence; and makes pleasant what is otherwise most irksome. Moreover, the exercise is well and equally distributed over almost the whole body, and, as Parkes says, when all the muscles are exercised no muscle is likely to be overexercised. This general muscular exercise also has its direct effect upon the other and vital organs of the body, the heart, lungs, and digestive organs especially; and the improvement in general health and digestion, after a few weeks' riding, is by no means illusory or fleeting. We all know that the trouble with many of our patients is purely functional, and that their maladies have been brought on by lack of pure air, too little exercise, and too much mental worry over their work or business. For these the bicycle furnishes an agreeable remedy." It is thus recommended specifically for venous or anæmic dyspepsia, torpor of the liver and intestines; for tuberculous diathesis, incipient consumption, nervous troubles, rheumatic disorders; and "is destined to be of great benefit to women. It gets them out of doors, gives them a form of exercise adapted to their needs, neither too violent not too passive, one very pleasant withal that they may enjoy in company with others or alone, and one that goes to the root of their nervous troubles." A correct position in bicycling is important; it is the upright one, and not "a posture resembling a half-opened jackknife," which cramps the chest and interferes with the flow of blood. Excess either in quantity or intensity of bicycle work must be avoided.

**"Crocodile Tears."**—The figure "crocodile tears" rests, it appears upon a real fact, although the tears appertain more particularly to the snake. According to the explanation of the matter offered by Mr. R. H. Burne, of the Royal College of Surgeons, the eye of the snake is protected from dust, etc., by the eyelids, which are transparent and joined to each other so as to form a layer of skin between the eye and the outer lid; in other words, the snake always goes about with its eyelids shut. Thus the real occupation of the tears is gone, there being no dust on the surface of the eye to be washed off. Instead, however, of the tear-gland being reduced in size, it is exceptionally large; in some snakes, indeed, in which the eyes are reduced and practically functionless, the gland is some two or three times larger than the whole eye. This peculiar state of affairs was explained by the discovery that the gland had lost its connection with the eye, and opened through the mediation of the tear-canal directly into the mouth, thus doubtless, by means of its secretion, making the descent of Avernus smooth and easy to any unfortunate creature that this snake may have taken a fancy to. This is possibly not quite what was meant by the fable of the crocodile's tears, but it affords a curious

example of how very near a false popular superstition may unwittingly come to the truth.

**The Limits of Parental Discipline.**—The point to which parental discipline may go might be made a subject of fruitful study. It is agreed, of course, that the child must be trained and kept in a certain degree of subjection for its own good and to prevent its becoming a nuisance to society, and a certain pliancy to the control of superiors is, as a writer in an English journal well remarks, absolutely essential to the organization of a household, a school, or a state. "Discipline," this writer continues, "implies ready obedience to orders of which the reason is not understood; but it should always rest on the belief that these orders are given for sufficient reasons, and not for the mere satisfaction of those who give them in seeing them obeyed." The theory of "breaking" the will of the child, in which parents and teachers indulge, is all wrong. The first thing a superior has to learn "is that there is no such thing as property in the character of a human being; that when the individuality of a character has to be suppressed—and of course the organization of society requires that it must often be suppressed—it is suppressed either for its own good or for the good of others to whom consideration is due, and that, beyond the limits of these obligations, individuality, far from being a hindrance and annoyance to be got rid of as completely as possible, is a distinct gain to the universe. The wish of some parents to wield as much power over the wills and characters of their children as they do over the motions of the horses they ride or drive is not only a foolish but an evil wish. To get excellent instruments on which they can perform as they would perform on a piano, always eliciting exactly the particular vibration they desire and expect, is clearly not the true object of family life. On the contrary, character, far from being an instrument to be performed on by others, should always be a new source of life and originality, which no one should be able to govern despotically from the outside, and which, even from inside, is in a great degree a mystery and a marvel to him who has most power over it. The mere notion of making character a kind of repeater, which responds by a given number of strokes to the parent's touch, is a radically absurd one. What a parent ought to wish for is, indeed, instant obedience to orders given for the child's good, and an eager intelligence in the child to trust its parent; but beyond this, as much that is distinct and individual, and that has a separate significance of its own, as the child's nature can provide."

**Vitality in Intellectual Work.**—So far from intellectual work diminishing vitality, says a writer in the London Spectator, the chiefs of all the intellectual professions are, and in recent times have been, men who have passed the ordinary term of years with undiminished powers. In politics the principal leaders whom this generation has known have been Earl Russell, Lord Palmerston, Lord Beaconsfield, and Mr. Gladstone, and every one of them was at seventy in full vigor, while the last, at eighty-three, is still a mighty power in British politics. Prince Bismarck remains at seventy-eight a force with which his Government has to reckon; while the will of Leo XIII, an exceptionally intellectual Pope, at eighty-three, is felt in every corner of the world. "The most intellectual and successful soldier of our time, the man who had really thought out victories, Marshal von Moltke, was an unbroken man at ninety and more years. No men dare compare themselves in literary power with Tennyson or Carlyle, Victor Hugo or Von Ranke, and they all reached the age which the author of Ecclesiastes declared to be marked only by labor and sorrow; as also did Prof. Owen, whose life was one long labor in scientific inquiry; and so also has Sir William Grove, one of the most strenuous thinkers whom even this age of thinkers has produced. We might lengthen the list indefinitely; but to what use, when we all know that the most intellectual among lawyers, historians, novelists, physicians, politicians, and naturalists survive their contemporaries, usually with undiminished powers? In all statistical accounts, the clergy, whose occupation is wholly intellectual, rank first among the long-lived. A little lower down in the scale the most hale men among us are those who have been doing intellectual work, often extremely hard work, through all their lives,

and who are still so strong that all the professions are affected by their resolution not to retire, and the inability of younger men to invent a reason for making their retirement compulsory. To say that they are picked lives is false, for they are so numerous that the intense vitality of the old and intellectual actually affects the organization of society; and to say that the unintellectual flourish equally well . . . is not probably true." The stupid among the cultivated do not survive in anything like the same proportion. Among the ladies of the century, likewise, the oldest have been the highest.

**Science in Elementary Schools.**—Remarking, in a paper, on the Place of Science in Elementary Schools, Prof. Samuel G. Williams observes that all sciences of Nature have their very foundation in correct and definite observation of the facts which Nature presents. It is therefore of the very essence of science that the pupil should be first of all taught to observe, to use his own senses directly upon appropriate objects, and thus to increase their delicacy and power by repeated employment; and, moreover, to give an account of what he has in any way experienced, that the fact observed may be assured and that its results may be embodied in language. When even the youngest child is thus brought into direct contact with Nature, he is quick to note the infinite variety which it presents, to see that this object is similar to that and quite unlike the other. Incipient powers of comparing and judging emerge, and should be appealed to in all possible ways; for ripeness of judgment results only from repeated acts of judging. Rude and then more perfect classifications result from the grouping of the like and the separation of the unlike; and the beginning of class notions is made which future experience shall fill with even clearer and more definite meaning, until gradually and almost unconsciously the pupil grows to a considerable mastery of the general and abstract terms which make so large a part of the language of the more enlightened members of his race. Even those large operations called generalization and induction from observed facts and phenomena, should have their definite beginnings in some part of the elementary course, and especially in certain easy and natural observations of physical phenomena. The youngster whose attention has a few times been directed to the flash of a distant gun and the report which more tardily reaches his ear, can readily be brought to infer that sound travels more slowly than light, and to apply his generalization to lightning and the resultant roll of thunder. Thus, it is obvious that the aim which the science teacher should keep ever clearly in view is first of all to train the senses to ever-growing accuracy and completeness in observation; as accessory to this, to secure the expression and interpretation of what is observed; to neglect no opportunities, however slight, for the exercise of judgment; and to advance, gradually indeed, but always with definite purpose, toward the classification and generalization of results secured by direct personal observation. It will be observed that the keynote of the whole matter is *direct contact* with Nature, and diligent study of what she has to teach through the proper use of trained senses.

**Fighting the Gypsy Moths.**—The State Board of Agriculture of Massachusetts, through its agents, Prof. C. H. Fernald and E. H. Forbush, appears to be carrying on an effective campaign against the gypsy moth. The work was begun systematically in 1890, so that only the results of the first two season's operations have yet been embraced in the official report; yet, though the attempt was the first on a large scale ever made in the Commonwealth to destroy a species of insect, and the operators were without experience, a very perceptible reduction in the number of the insects and in the damage by them was realized; and trees and orchards that were stripped in 1891 enjoyed the full luxuriance of their foliage in 1892; and the members of the board are now confident that it can be eradicated. Destruction of the insect is found to be a most effectual method of eradication. Another method is to entrap the caterpillars within bands of burlap fastened around the trees. They are in the habit of seeking shelter during the daytime, and if the holes in the trees are stopped up they resort to the burlaps and can then be easily destroyed. When the insects get into the woodlands, dealing with them is more difficult, on account of the un-

derbrush and the dead leaves on the ground. In these cases the board suggests clearing away the brush and the worthless trees and careful burning over the ground. When the work was first begun it was thought that the moth occupied only a small part of one town. It was, however, shown that it infested thirty towns and cities. As the moth multiplies rapidly and eats everything that is foliage, leaving nothing behind, the danger arising from its presence is really a matter of national importance.

**Superstitions about Snakes.**—In his refutation of Some Superstitions about Snakes, Dr. Arthur Stradling tells of a "weirdly horrible" fancy of the Singhalese Tamils, that every time the cobra di capello bites and expends its venom after it has attained its full length, it loses one joint of its spine. The process of curtailment goes on until the whole body has disappeared, with the exception of the head and hood, both of which have undergone a sort of compensating enlargement, while the mouth has widened until the face of the reptile presents the aspect of a malignant toad. With increased death-dealing powers, the exercise of which subjects it to no further penalty, it now betakes itself to an aërial mode of life, flying by the flapping of its extended sides after the manner of a bat. A somewhat similar fable is heard among the natives of Bengal, who furthermore declare that this square-winged fiend is the only snake that refuses to be frightened away when the name of the king of the birds (Garudá) is called aloud in its hearing, and that the docking of the vertebræ corresponds to the number of human lives which the cobra has sacrificed in former days. This superstition is curiously akin to that held by the settlers in many parts of America, to the effect that the rattlesnake acquires a new thimble to its rattle for every man it kills.

**Cruelty to Children.**—From the report of the English National Society for the Prevention of Cruelty to Children it appears that poverty and large families are not a common cause of cruelty. On the contrary, the worse the cruelty the better, on an average, were the wages of the cruel parent and the fewer the children to whom the cruelty was displayed. The report further shows that the effect of warnings and even of prosecution and conviction on cruel parents is not to inflame their passions against the children who have been the occasions of their alarm and punishment, but to increase the regard of the cruel parent for the children, and for those who interfered to protect them. The cruel parent becomes less cruel when he finds that the law concerns itself with his children, and often seems to discover that there is a good deal more to like and respect in the children who had been cruelly treated, and in those who took the children's part, than he had perceived before. Summing up the domestic effects of a visit of the society's inspector, a mother said to one of the secretaries of the society, "It is like courting over again." In other words, as an English journal views the case, the woman had risen in the estimation of her husband as soon as he found that the law and public opinion of the neighborhood were on her side. Instead of increased irritation against his wife for not siding with him, he felt her to some extent raised above him, and began to see her with new eyes as a person whose approbation it was worth while to gain. The prevalence of cruelty among well-to-do parents rather than among the lowly is, perhaps, to be explained on the same principle. Cruelty is favored by the sense of arbitrary power, and by the absence of any feeling of responsibility to others. Anything that stimulates the sense of irresponsibility and independence increases cruelty; anything that diminishes that sense, anything that brings home to the heart the feeling of a social or physical yoke, diminishes it.

**Steamboats on Long Island Sound.**—From a Review of the Past and Present of Steam Navigation on Long Island Sound, published by the Providence and Stonington Steamship Company, it appears that experiments to move steamboats were made by several persons toward the end of the last century on the Hudson and the Delaware. John Fitch's was the first, and his skiff, rowed by oars or paddles on the sides, moved by cranks worked by steam machinery, was publicly tried on the Delaware, July 27, 1786. An amazing contrast is presented between its portrait and those of the Stonington line's

latest masterpieces in steamboat architecture, the Maine and New Hampshire. Fitch's first boat for carrying passengers was completed in 1788. It was worked with oars or paddles placed at the stern and pushed against the water, and took thirty passengers from Philadelphia to Burlington in three hours and ten minutes, or over six miles an hour. Fitch's third boat was advertised in 1790 as "the Steamboat" to run to Burlington, Bristol, Bordentown, and Trenton, and return the next day. Congress adjourned to see it start, and the Governor and Council presented it with a flag. The Eructor Amphibolis of Oliver Evans was a combined locomotive and steamboat—a scow on wheels with modern axletrees and a paddle wheel behind, to travel as a wagon on land and as a boat in water. It was propelled by the engine up Market Street in Philadelphia and round the circle to the waterworks, where it was launched into the Schuylkill. The paddle wheel was then applied at its stern, and it thus sailed down that river to the Delaware. Then came Fulton's Clermont, steaming from New York to Albany in thirty-six hours, the pioneer in a fleet which numbered eight boats in 1816. The first steamer on Long Island Sound was the Fulton, a vessel with one mast and sloop rigging, which depended on its sails to accelerate its speed, and began its trips to New Haven in 1815; and the Fire Fly, one of Fulton's boats, first rounded Point Judith and reached Newport in 1817. The establishment of the packet line between Providence and New York was an important event in American travel, and the departure and arrival of the boats presented an imposing spectacle. The fare was ten dollars, and the first advertisement of the company appeared under the cut of a man-of-war, with portholes open and every sail set. In their painting, these boats, according to the account, somewhat resembled a barber's pole, being striped in curious designs.

**Unsolved Problems in Geology.**—Rather technical is Mr. G. K. Gilbert's review of the continental problems that are before geologists for solution, made in his presidential address before the Geological Society of America; but he enumerates several such problems and questions on which no clear light has yet been thrown. As he summarizes them, it appears that "the doctrine of isostasy, though holding a leading position, has not fully supplanted the doctrine of rigidity. If it be accepted, there remains the question whether heat or composition determines the gravity of the ocean beds and the levity of continents. For the origin of continents we have a single hypothesis (that laid down by Prof. Dana in his Manual of Geology), which deserves to be more fully compared with the body of modern data. The newly determined configuration of the continental mass has yielded no suggestion as to its origin. The cause of differential elevation and subsidence within the continental plateau is unknown and has probably not been suggested. The permanence of the continental plateau, though highly probable, is not yet fully established; and the doctrine of continental growth, though generally accepted, has not been placed beyond the field of profitable discussion. Thus the subject of continents affords no less than half a dozen great problems, whose complete solution belongs to the future. It is not altogether pleasant to deal with a subject with regard to which the domain of our ignorance is so broad; but, if we are optimists, we may be comforted by the reflection that the geologists of this generation, at least, will have no occasion, like Alexander, to lament a dearth of worlds to conquer."

## NOTES.

Wood ashes are recommended in the American Agriculturist, by Mr. J. M. Stahl, as a valuable medicine for farm animals. The author keeps them, with charcoal and mixed with salt, accessible to his hogs, with the best effects; and he furnishes them to his horses by putting an even teaspoonful with the oats twice a week or by keeping the ashes, with the salt mixture, constantly before the animals.

The most striking feature of Mr. A. T. Drummond's examination of the colors and times of flowering of five hundred and thirty-nine of the plants of Ontario and Quebec is the preponderance of white flowers, which form rather more than one third of the whole. Following them are the yellow flowers, largely composites, which include about one quarter; while the purples and blues are much less numerous, and comprise about one ninth and one tenth respectively of the whole. In time of flowering April, May, and

June are remarkable for the prevalence of white; July, August, and September of yellow; and September and October of purple and blue.

The caves of Mount Elgonin, East Africa, extend right round the mountain and occur in the lava as well as in the agglomerate beds. Mr. J. Thomson believes that they are old excavations; but a correspondent of the London Times, who visited them in February, 1893, has come to the conclusion that they are merely vast blow-holes in the mountain, "which is a grand specimen of an extinct volcano, the crater being some eight miles in diameter and from fifteen hundred to two thousand feet in depth." The mountain is fourteen thousand feet high, with a base of about one hundred and fifty miles in circumference.

The report of the Massachusetts State Board of Health on the Geographical Distribution of Certain Causes of Death in that State presents the results of an inquiry respecting the relation of paper mills to smallpox mortality. In eleven cities and towns having extremely high ratios of smallpox mortality, six contained one or more paper mills in which rags were used; and a list of twenty-eight cities and towns in which there are paper mills contains only four places in which there were no smallpox deaths during twenty years, and non-fatal cases are known to have occurred in two of these towns. Frequent investigations of the board have shown that smallpox in Massachusetts is very often due to infected rags. In many of these cases it appeared probable that domestic rags collected in the large cities of the United States were the source of infection.

A settlement of the silver question is propounded by Mr. Roderick H. Smith, author of several works on business, which he believes will be sovereign and permanent. It is the enactment of a law, of which he submits a draft, the essential feature of which is a provision for the issue by the Government of certificates against deposits of silver, which shall be redeemable, on demand, in an equal value of silver to the amount of the deposit. Thus, whatever may be the fluctuations in the value of silver, the certificates can never command more than they are actually worth.

The Massachusetts State Board of Health, inquiring into the distribution of cholera infantum, finds the disease apparently promoted by the employment of mothers away from home. It also finds that a high mortality rate from cholera infantum occasionally exists in a comparatively small town where there are one or more densely populated manufacturing villages in which the conditions of living may resemble those of a large city. Upon this point Dr. Haven says: "We may have all, or nearly all, of the most vicious conditions of city life in a single tenement house in some small town of perhaps only a thousand inhabitants; we may have, that is, the heat, the dirt, the overcrowding, the bad drainage, and the artificial feeding which are the concomitants of city life."

Experiments by Grassi, Cattani, Tizzoni, Simmonds, and Sawchenk, made under various conditions and in great diversity of forms, are confirmatory of one another, and afford cumulative evidence of the competency of flies to convey cholera germs. Sawchenk even suggests that the bacilli may be able, under suitable conditions, to multiply within the bodies of flies; in which case, besides being dangerous carriers of infection, the flies would be a veritable hotbed for the preservation and further multiplication of cholera bacilli.

A remarkable illustration of the perseverance shown by roots in seeking food is related in Nature by the Rev. W. H. Oxley, vicar of Peterham. The roots of a wistaria entered the dining-room of Eden House, Ham, by a very small chink in the side of the window near the ceiling. On removing from the walls the paper, which had not been disturbed for many years, the whole of the plaster beneath was found covered with a fine network of roots spreading all round the room. There was no appearance on the paper to give rise to any suggestion of the presence of roots being there. Prof. Dyer remarks that the roots seemed to have behaved more like the mycelium of a fungus than an ordinary axial structure. The room was constantly inhabited, with fires.

The Italian Minister of Public Instruction, Signor Martini, has called the attention of the Chamber of Deputies to the evils of overpressure in the public schools, under which the programmes have been enlarged without corresponding enlargement of the cerebral convolutions, and the pupils are "swallowing much and digesting little." "While the able-bodied artisan," he says, "demands the restriction of his labor to eight hours, we exact from our boys of ten a labor at once more prolonged and more severe." The minister has been quick to learn from the lessons given him, and has already instituted reformatory measures. The tasks to be undertaken after school hours have been minimized, inducements to prolong mental labor beyond the just limits have been diminished, and the overstrain due to excessive competition is discouraged; the number of subjects to be taken up at once is curtailed, the schools have developed a "modern side," and happy results and improvement are already visible.

In a recent "long-distance walk" between Berlin and Vienna—some three hundred and sixty miles—the winner among fifteen com-

petitors accomplished the distance in one hundred and fifty-four hours and forty-five minutes, and the one next behind him in a little more than one hundred and fifty-six hours. The winner, however, came in exhausted, while his competitor seemed not to have suffered at all. Both lost five pounds in weight. The remarkable fact about the feat is that these two foremost men are called vegetarians, and were able to walk an average of eighteen hours a day for seven consecutive days on the kind of diet classed under that designation.

Four sulphurets are named by M. Jacksh, of Triesch, Moravia, as becoming phosphorescent after a brief exposure to daylight—viz., the sulphurets of calcium, strontium, barium, and zinc. The last compound has been obtained in a luminous condition only recently by distillation in a vacuum. Prepared in the usual way, by precipitating soluble salts of zinc with sulphurets, it shows no signs of phosphorescence. Sulphuret of barium gives a yellowish-orange glow, but only for a few minutes after each exposure to the light, and is of as little use as the sulphurets of strontium and of zinc, the greenish glow of which disappears after about two hours. For practical uses the sulphuret of calcium of commerce is the only phosphorescent of value. Pure, it gives a faint yellowish light; but treated at a red heat, with the addition of a small quantity of a salt of bismuth, it is transformed into a substance giving a violet light and retaining its luminous quality for nearly forty hours after an exposure of only a few seconds.

Records kept by Dr. Spengler at Davos Platz for two years and a half, resting largely on communications kept up with the patients after leaving, show that a permanent cure (of consumptive diseases) is apparently effected in 42·8 per cent of the cases. It is noted that most of the patients were subject to influenza in the epidemic of 1889–'90. In the treatment, till acclimatization is completed and the patient has slept well one or two weeks, he lies much in the open air, and takes little exercise. Patients who come with fever soon lose it.

Alcohol, although the most convenient heretofore found, has proved an unreliable fluid for low-temperature thermometers. It is subject to the three vices of sticking in the tube, irregular expansion, and defect from impurities and variations in water content, which affect its expansion materially. M. Chappuis has found toluol, the boiling point of which is 110° C., a liquid well adapted to the purpose and free from these disadvantages.

The Psychological Section of the Medico-legal Society is interested in all that pertains to psychology, and purposes, through committees appointed from among its members, to make special studies in the departments of animal magnetism, hypnotism, telepathy, clairvoyance, supposed apparitions, and other claims of "respectable" modern spiritualism. It is intended to conduct these inquiries and investigations with candor and fairness, upon strictly scientific lines, and to reach, in so far as possible, a valuable and enlightening collection of facts incident to these phenomena, from which important deductions may be made.

Experiments, pursued during two years by himself and his associates, are recorded by Prof. Chodat, of Geneva, concerning the influence of static electricity on vegetation. Beans, sorted into two equal lots, were similarly planted in a vessel filled with sawdust moistened with the same quantity of water, and exposed to identical conditions of warmth and light. One of the vessels was put under electrical influence during a part of the day, rising from forty minutes at the beginning to three and four hours. Leaves began to appear in the electrified lot on the fourth day, while the other lot as yet showed no signs of them. The difference was plainer on the fifth day, and still more so on the seventh, when the electrified plants had grown to a considerable size, while the non-electrified ones were only just starting. The difference was also apparent in the superior vigor of the stems and roots of the electrified plants. The experiment confirmed the opinion that electricity acts to promote germination and growth in length; but the leaves of the non-electrified plants obtained a better development than the others.

## OBITUARY NOTES.

The Rev. T. Wolle, pastor of the Moravian church, Bethlehem, Pa., whose death was recently announced, was an ardent student of fresh-water algæ, and author of three important publications on the Fresh-water Algæ, the Desmids, and the Diatoms of the United States.

Cavaliere Giuseppe Antonio Pasquale, Professor of Botany at the University of Naples, and Director of the Botanic Garden, who has recently died, was the author of several books, chiefly those on the flora of Vesuvius and the flora of Capri.

The death is announced of Dr. Karl Semper, author of the book in the International Scientific Series on the Natural Conditions of Existence as they affect Animal Life. He was born at Altona, in 1832; studied at Würzburg, chiefly in zoölogy; made a scientific journey in 1859–'62 through the Philippine and Pelew Islands, the results of which were published in several valuable works; became Professor of Zoölogy at Würzburg in 1868, and a few years later Director of the Zoölogical Institute there.

WERNER SIEMENS.

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# ELECTRICITY AT THE WORLD'S FAIR.

By CHARLES M. LUNGREN.

## I.

A PERIOD of but seventeen years separates the first great American exhibition from the second, yet what a vast difference between the two in the display of electrical appliances! The Centennial was not indeed without its electrical wonders, but these were unobtrusive and formed but isolated examples in an industrial domain which yet remained to be cultivated. Electricity had not then been brought home to the attention and interest of the thousands by multiplied daily use. It made no appeal to the imagination, and the immediate future that was to open for it was hardly dreamed of even by those in the vanguard of electrical discovery. The telephone here made its *début* ; the quadruplex telegraph, but recently put into commercial service, was here shown for the first time ; and the dynamos and arc lamps of Wallace were on exhibition. The Gramme machine, which was shortly to play such an important part in the commercial development of the electric light, and to prove such a stimulus to the inventors of electric apparatus, was also to be seen here, but beyond these electricity was very little in evidence at the earlier exposition. At the Columbian it is omnipresent. It is called upon to do the lighting of the great buildings and grounds, to the exclusion of all other means of illumination ; to drive the trains of the intramural railway which winds through the exposition inclosure ; to propel the graceful launches which glide through its waterways; to furnish the power distributed throughout the various buildings, and to make itself known in innumerable decorative effects. Grown too large to have a place merely, along with other

industries, in a general building, it has a temple of its own, which is filled with the manifold applications of this strange and subtile agent to the arts and conveniences of life. And even this is inadequate to the demands it has made upon the space of the exposition, for what may rightly be considered two of the main exhibits—the great alternating lighting plant and the direct-current plant of the intramural railway—are without the inclosure of the Electricity Building, the one in Machinery Hall and the other in a structure by itself.

Complete and varied as the Columbian electricity exhibit is, it is not primarily an exhibition of novelties. It is rather a summing up of our progress to date—a slice taken from the far larger exhibit which everywhere surrounds us and is helping to do the daily work of the world in shop and factory and mine, on our streets and in our homes. Much of that to be seen is already familiar, but it is not on that account devoid of either interest or instruction. In the actual industrial world the processes and appliances of an art are scattered and not easily accessible, and it can only be studied piecemeal and with difficulty. A great exposition, on the other hand, gives an opportunity for studying an art in its entirety, and thus enables an observer to gain a clear conception both of the attained progress and the direction of future development. This opportunity is afforded by the Columbian in a marked degree. Illustrative examples are to be found in it of all the more notable steps of progress, and many of the exhibits are remarkably full and complete.

The visitor will find, for instance, an opportunity to study the telephone from its earlier form up to the present standard instruments, and to inspect and perhaps understand for the first time the central station system, by means of which he is daily put into communication with other subscribers. He will see in actual working what he will have but little opportunity to see elsewhere, and which, to judge by the crowds which throng about it, appeals strongly to the curiosity and interest of the average visitor—the delicate siphon recorder of Sir William Thomson, by which all the cable messages of the world are received. And he may perhaps wonder that any one should be able to interpret into intelligible signals the curious zigzag scrawl which the siphon leaves upon the moving band of paper. He will also see a set of quadruplex instruments and be able to understand by actual inspection much better than by mere description this most important of telegraphic appliances. He will also be able to see in the Western Union exhibit the original receiving instrument of Morse, made of a triangle of wood hinged at its apex to an artist's canvas frame, and carrying at the center of its lower side a pencil, with which a zigzag tracing can be made upon a moving band of paper

beneath, as the triangle is swung to and fro under the impulses of an electro-magnet. The visitor will also have an opportunity to examine the new telautograph of Prof. Elisha Gray, by means of which the written word, it is promised us, may be transmitted to a distance with the same facility that the spoken word now is by telephone. Turning from this lighter and more delicate form of apparatus, the visitor will find a very complete display of the class of applications that has brought electricity into such close contact with the daily life of the masses in recent years. From the great Westinghouse lighting installation and from the power plant of the intramural he will get some adequate idea of a modern central-station equipment, while from the illustration of long-distance power transmission he will be able to comprehend one of the directions in which electricity holds out the greatest promise for the future. In the exhibits of electric welding and forging he will learn of the help the electric current is giving to the metal worker, and in that of cooking and heating the attempts that are being made to displace with electrical appliances the kitchen range and the hot-air furnace.

The most prominent exhibit of electricity at the fair is undoubtedly the lighting of the Exposition itself. This is carried out along lines already well established, and is remarkable chiefly for the great scale upon which it is planned and executed. Nearly five thousand arc lamps and a hundred thousand incandescents have been called into requisition for the illumination of the grounds and buildings. The placing of these required, no doubt, a great deal of detail work and called for nice discrimination in adapting means to ends, but involved no electrical problems of especial novelty. The lighting of the big Manufactures Building, with its thirty acres of main floor space and ten acres of galleries, presented the most difficult problem to the Exposition authorities, but this has been successfully solved by the use of the arc lamp hung from immense coronas along the central line of the building, supplemented by individual lamps in the corridors, galleries, and separate rooms. The coronas are hung a hundred and forty feet from the floor and sixty feet from the crown of the great arched roof which spans the structure, and are of colossal size, the central one being seventy-five feet in diameter and the two which flank it on either side sixty feet. Something over four hundred lamps are disposed of in this way, while to these are added some twelve hundred more to complete the lighting of this great inclosure. The incandescent, so flexible in the hands of the decorator, has been used very effectively to outline the buildings and the waterways of the Exposition, in addition to their use in interior illumination.

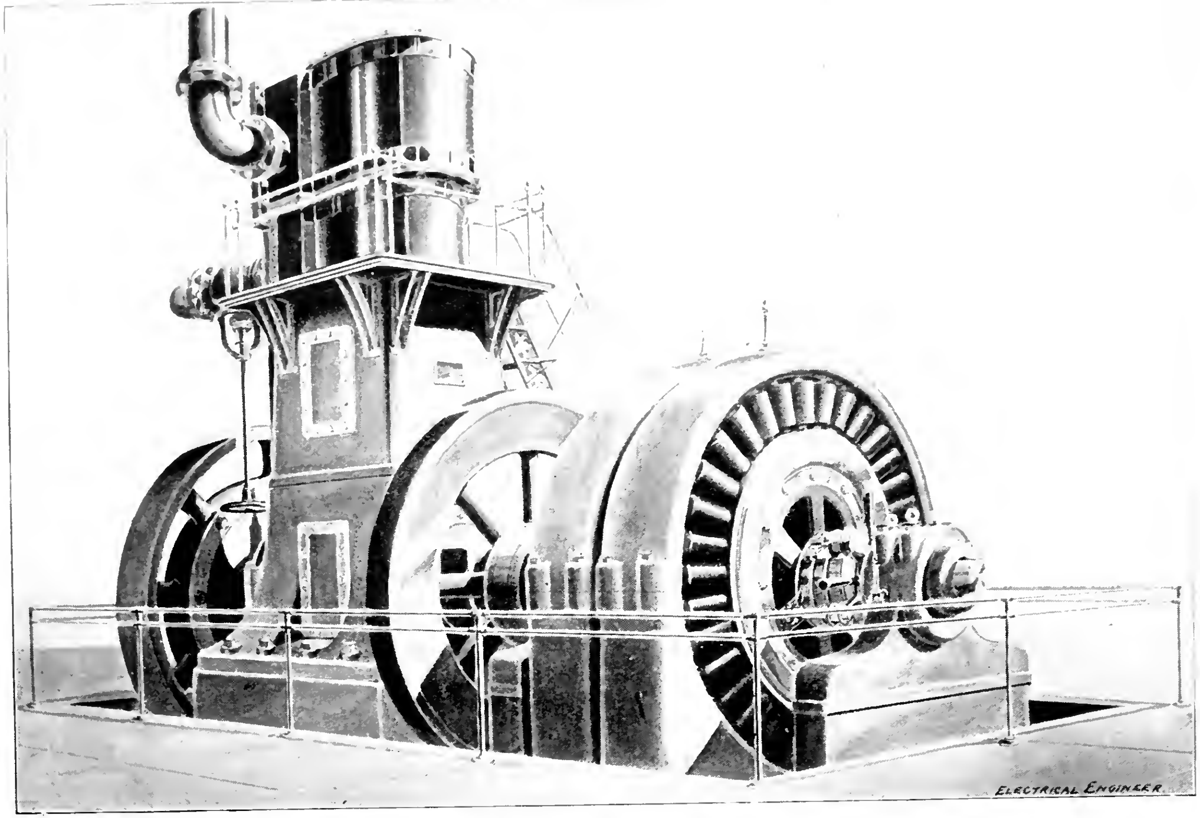


FIG. 1.—WESTINGHOUSE TEN-THOUSAND LIGHT ALTERNATOR. (From the Electrical Engineer.)

The power and machinery which give vitality to this vast array of lights are to be found in Machinery Hall, and constitute one of the chief electrical exhibits. The most striking feature of this exhibit is the great Westinghouse alternating plant, which supplies the current for the incandescent lamps. It consists of twelve enormous alternating-current generators, each having a capacity of ten thousand sixteen candle-power lamps and requiring a thousand horse power apiece to drive them. They are arranged in two groups, the first six of which are coupled direct to Westinghouse upright engines. Of the remaining six, four are driven separately by different makes of engines, and two are belt-driven in tandem fashion by an Allis-Corliss cross-compound engine nominally rated at two thousand horse power, but which may be worked up to three thousand horse power upon occasion. This engine is one of two of the same type and by the same maker, the other one being stationed in the power house of the intramural railway, and is regarded as a very fine example of modern steam engineering. The alternating generators themselves are of a type only recently devised, in which there is a double row of field poles, and a double set of armature coils, by means of which the machines can supply two separate circuits for the requirements of incandescent lighting, or furnish what is known as a two-phase current for use with alternating-current motors. The current as generated has a pressure of two thousand volts, which is reduced down, at the point of consumption by means of converters, to fifty or a hundred volts.

Besides the "alternators," as these machines are technically termed, there are a large number of direct-current machines in this building supplying the currents to the arc lamps, and the motors scattered through the various buildings. The plan adopted by the Exposition authorities has been to confine the engines and boilers to Machinery Hall, so that all the power required in the Exposition except that for the intramural railway, is generated here and transmitted by electricity through underground conduits to the place where it is to be used. The exhibition is therefore an illustration of the electric transmission of power upon a large scale, and should furnish a basis for the collection of instructive data.

The feature of the Exposition which will command the most interest of any of those in which light plays a prominent part will probably be the electric fountains. Fountains of this character have been features of a number of exhibitions since 1884, when the first one, designed by Sir Francis Bolton, was shown at the Healtheries in London, but those at Chicago are upon a much greater scale than any heretofore attempted. The principle of operation is that of throwing a powerful beam of light from be-

low upward along the axis of the water jet, the lamps being placed in a chamber under the fountain provided with a transparent roof. Color effects are produced by the interposition of glass screens in the path of the beam. In the present fountains, which rise from basins sixty feet in diameter, the underground chamber is built upon piling, a construction rendered necessary by the shifting sand foundation. The piling is of unequal length, the shorter piles supporting the floor structure, and the longer, which project through and are seen as pillars in the room, the roof. The water nozzles are grouped to form nineteen composite jets, and as many power-

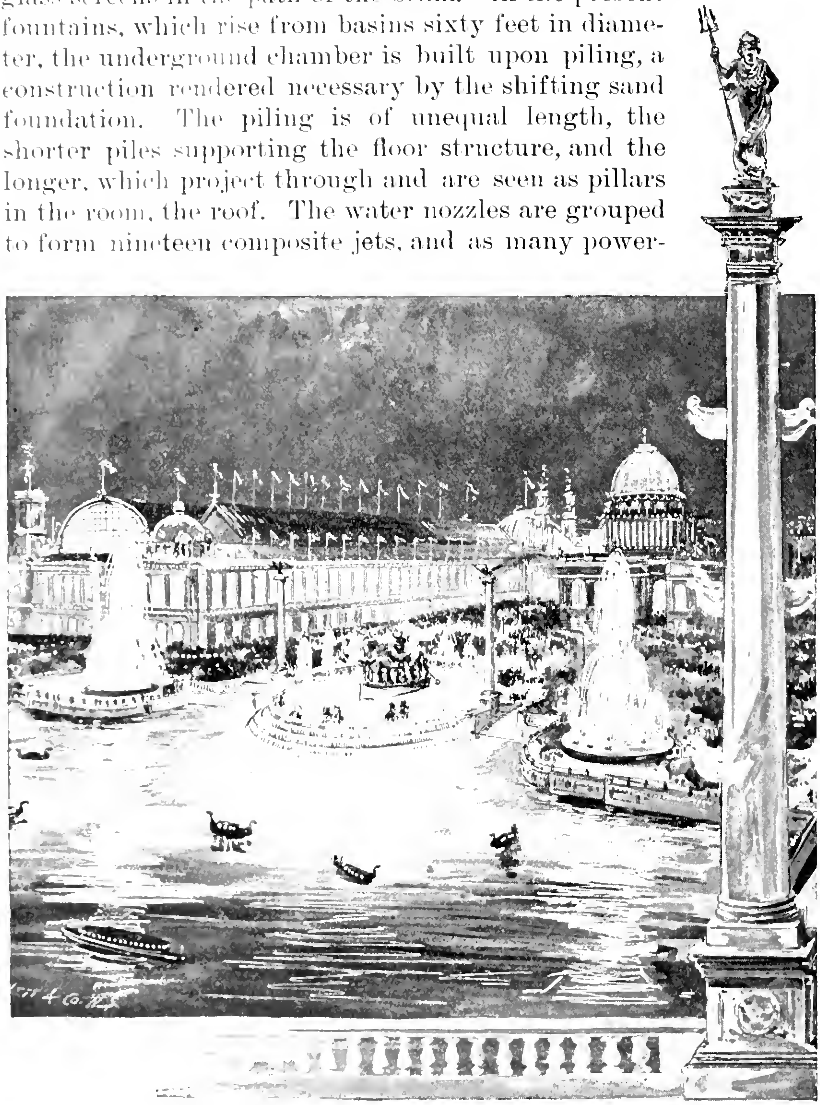

Fig. 2.—Electric Fountains.

ful reflectors are arranged to throw a beam of light along the axis of each group. It is estimated that the beam of these powerful lights has a luminous intensity of two hundred and fifty thousand candles. The size of the fountains may be appreciated by the fact that they require a twenty-four-inch supply main con-

veying water at a hundred pounds pressure, and have a consumption of nearly twenty-one million gallons per twenty-four hours. The central jet or grand geyser formed by a two-inch stream rises to a height of a hundred and fifty feet. The color screens are in the shape of fan blades arranged to rotate horizontally, and are grouped so as to be capable of producing an almost unlimited combination of color effects.

If any demonstration were needed of the capacity of the electric motor to take the place of steam on such roads as the elevated in New York and Chicago, or of the enormous superiority of electric traction in the matter of cleanliness, comfort, and freedom from noise, the intramural would furnish it to the satisfaction of any impartial observer. This road is a double-track elevated structure something over three miles in length, which forms the highway of communication between the different buildings. It is purposely laid out with many an unnecessary curve, to accentuate the conditions of actual travel, and demonstrate the ability of electric traction to do its work satisfactorily under extreme conditions. The trains are made up of a motor car and three trailers, all four cars being arranged to seat passengers, the space occupied by the motorman at the extreme front end of the motor car being no greater than that of the ordinary trolley car. The cars are open, with the seats extending clear across the car body, each pair facing upon the entrance aisles. These aisles are closed by sliding gates, which are connected so that all those on one side of the car may be opened or closed at the same time by the movement of a lever at the end of the car. This construction might be very readily adapted to a closed car, and would seem to be admirably suited to cars having the phenomenally heavy traffic of those on the elevated roads of New York. A very noticeable feature of the cars is the perfection of the lighting. Too often, when electricity has been called upon for the lighting of public conveyances, there has been but little improvement over former results, due both to the bad habit of placing the lights in the aisle spaces and stinting in the candle power. In the intramural cars particular attention has been paid to securing abundant light, the lamps being up to candle power and placed in the most effective position along the sides near the car roof.

The electrical equipment of the motor car consists of four motors having a combined capacity of over five hundred horse power. These are geared to the axles by a single reduction gear, and take their current from side rails through the medium of sliding shoes. The side rail was adopted in preference to a central one on account of the greater simplicity of the switching arrangements, the facility in getting at the contact shoes, and the very

limited space between the motor and road bed in which to make a satisfactory rail contact. The return path for the current is through the traffic rails and iron girders of the elevated structure, the rails being copper-banded at the joints and joined by bands of the same material to the girders. Feeder rails extend from the power house for three fifths of the length of the line and are cross connected to the supply rails at every rail joint. The train equipment of the road consists of eighteen trains, weighing when loaded about ninety-six tons each, the motor car accounting for thirty tons of this weight and the other cars for twenty-two tons each.

The central figure of the power-house equipment is the great two-thousand-horse-power generator from the shops of the General Electric Company, said to be the largest machine yet built. It occupies the middle space of the power house and is driven by an Allis-Corliss cross-compound engine, which is a duplicate of the one in the Westinghouse plant in Machinery Hall. It is a direct-current machine of what is known as the multipolar type. This is a type of machine which has been developed in recent years in response to the increasing demands of railway power and central lighting stations for larger units of power. In machines of the power desired slow speed becomes essential, and this requirement has resulted in radically transforming the design of the dynamos. The two-pole field magnet, common in all machines a few years back, has given place to a multipolar one, generally made in the form of a ring-shaped yoke with inwardly protruding pole pieces, though this construction has been reversed in some large generators constructed by Siemens, in which the field poles radiate from a central hub, and the armature, made in the form of a flattened ring or band, is placed on the outside, its outer surface constituting the commutator upon which the brushes bear. A fine example of this machine coupled direct to a thousand-horse-power triple-expansion upright engine is to be seen in Machinery Hall. In the intramural generator the field consists of two massive semicircles of cast steel, bolted together, the lower of which is provided with supporting feet. This yoke is fifteen feet in diameter and three broad and with its twelve poles weighs over forty tons. The armature is what is known as the ironclad type, and is ten feet and a half in diameter, and weighs complete about thirty-five tons. The ironclad type of armature now used upon all railway motors and large generators is a comparatively recent development, and possesses marked advantages both mechanically and electrically. Its characteristic feature is the imbedding of the coils in the laminated iron core, either by forming tubular passages through this core near the edge or making it with open slots narrowed at the mouth to securely hold the

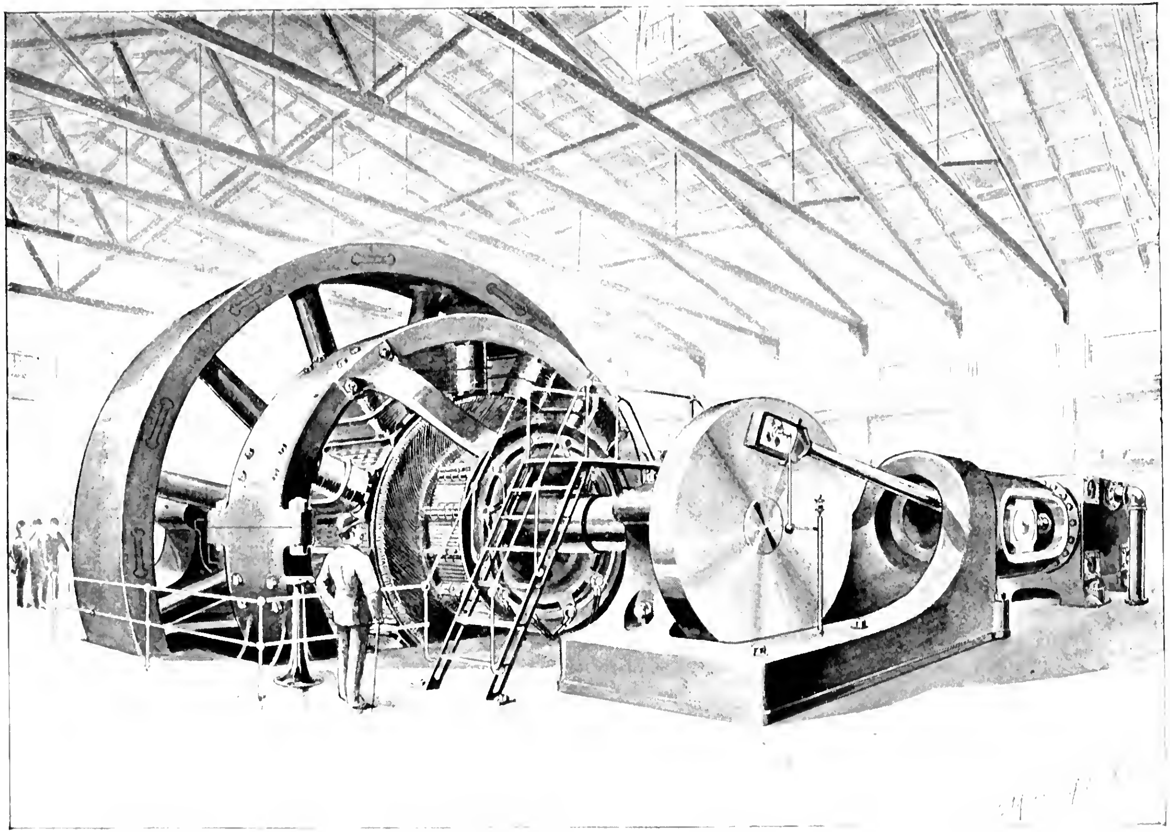

Fig. 3.—Intramural Railway Generator.

coils in place. It has the mechanical advantage of presenting a smooth exterior surface which can be turned true, and of holding the winding in such a way that it can not become displaced, as is possible with coils wound over the core and bound in place by a wrapping of wire. Electrically it has the advantage of materially diminishing the air gap—the space between the face of the armature and the field poles—and hence allowing the coils to move in an intenser magnetic field. The armature core is carried by a cast-iron spider weighing over fifteen tons which is keyed directly to the shaft of the driving engine. The brush holders, of which there are twelve sets, corresponding to the number of field poles, are mounted upon a yoke supported at one side of the field magnet frame. They are moved into position by means of a shifting gear operated by a hand wheel and are readily accessible from a stairway passing over the shaft. The machine is designed to run at seventy-five revolutions a minute and furnish a current under a pressure of six hundred volts. It has an electrical capacity of fifteen hundred kilowatts, and is claimed to have an efficiency of ninety-six per cent. This ponderous machine was found to be much too large and heavy to be shipped in its complete form, and was accordingly forwarded from the factory in parts and assembled upon its present foundation.

An appreciation of its size and capacity may be gained by remembering what the standards of size were only ten years ago when the Edison "Jumbo" was put to work in the first New York Central station. This machine, which created a veritable sensation at the Paris Exposition of 1881 on account of its immense size, required only a hundred and twenty-five horse power to drive it when working at its normal load. It had a capacity of less than one hundred kilowatts, which is but a fifteenth of that of the present "Jumbo," and weighed very much more in proportion to its output. It is to be seen in the exhibit of the General Electric Company, where it is rightly given a place of honor as the precursor of the race of modern direct-connected dynamos.

While a motor car will answer admirably for the lighter forms of electric traction, the invasion of the domain of the steam railroad, which electricians are already contemplating, will necessitate the design and construction of special electric locomotives. These have already been used quite largely in mine work, and a number of electrical constructors have designed and built such machines of moderate power, but the first one of any considerable size and designed for high speed is one built at the Lynn shops of the General Electric Company and shown in the Transportation Building at the Fair. It is a thirty-ton locomotive intended for a normal speed of thirty miles per hour, and is of sufficient

power for light passenger and freight traffic. It is mounted on four forty-four-inch wheels and is propelled by two gearless motors suspended in such a way as to leave the wheels free to adjust themselves to the irregularities of the roadbed. This method of suspension consists in mounting the motors upon spiral springs resting on the side frames of the locomotive truck, and the armatures upon hollow shafts through which the axles of the wheels pass, the connection between the two being made by uni-

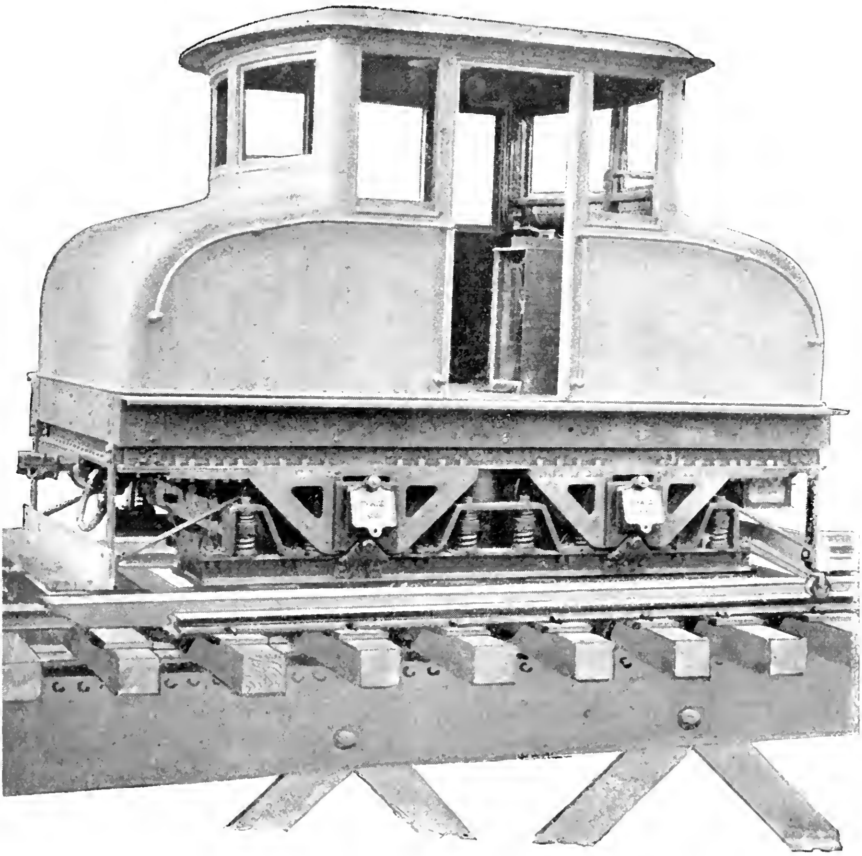

Fig. 4.—General Electric Thirty-ton Electric Locomotive.

versal couplings. The commodious cab is constructed of sheet iron, finished in the interior in hard woods, and is given a curved shape to diminish as far as possible the air resistance. The braking power is furnished by compressed air supplied by a special electrical air compressor, and the whistle is operated by the same means. The use of the electric locomotive is not yet practicable on long lines on account of the great cost of long feeders, but this bar to its employment is certain to be overcome in time. Wher-

ever traffic is dense and the distance to be traversed not too great, the conditions are already present for the advent of this form of locomotive; and when we recall the rapidity with which city and suburban railways have spread, we can not doubt that once the problems of electric railway engineering are worked out, and the necessary preliminary work of demonstration gone through with, we will witness an equally rapid extension of electric traction to the steam highways of the world.

Ever since Faure started electricians on the quest of an economical storage battery, the peculiar fitness of such batteries as a source of power for pleasure boats has been recognized, and they have frequently been used for such purpose. The slow develop-

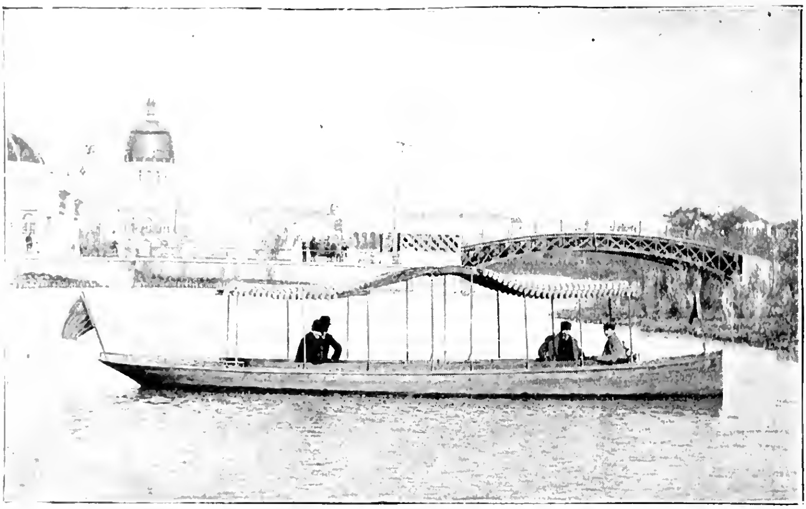

Fig. 5.—Electric Launch.

ment of this type of battery into an efficient instrument, the absence of any means of getting the batteries recharged, and the much greater cost of this method of propulsion, have heretofore acted to effectually prevent its adoption by the owners of such craft. But after riding in the launches of the exhibition one can not help but wish for the early dawn of the day in which this ideal method of water propulsion becomes generally available. The exhibition launches are of a very graceful model, about thirty-six feet long and six feet breadth of beam. They are designed to carry thirty passengers, and have motors capable of exerting four horse power. The batteries are placed beneath the seats and flooring, and as the motor is also beneath the flooring the cockpit is clear of any obstruction. Each launch carries seventy-eight battery cells, which, by appropriate connections, may

be grouped in various combinations. For the regular operation of the boats the cells are grouped in three divisions containing twenty-six cells each, arranged in series.

The batteries are charged for a run of ten to twelve hours, and are then recharged at the power station of the fleet in from five to seven hours. The launches run over a course of about three miles, at a speed of six miles an hour, and make landings at the principal buildings, all of which front upon the waterways.

To the engineer and to those who desire to know the trend of electrical development, the most interesting exhibit at the Fair will doubtless be the apparatus designed to show the long-distance transmission of power. Almost at the beginning of the modern electrical era, dreams were indulged in of the command which electricity was to give us of the natural sources of power. Marcel Deprez, at the Paris Exposition of 1881, had in operation a system of power transmission, and similar attempts have been made at every important exposition since, the most elaborate having been that at the Frankfort Exposition of two years ago. Of the importance of the economic transmission of power over long distances there can not be two opinions. The modern world has come to rest down upon an abundant and cheap supply of power in such a measure that without it civilization itself would go by the board. Statisticians have frequently shown that the coal supply, while large and ample for present needs, is not only exhaustible, but is being encroached upon at such a rate as to make its conservation a matter of grave concern. Electric transmission of power, by opening up to civilization the enormous supply of power of the waterfalls and running streams of the earth, will be able to postpone indefinitely the evil day that would be ushered in by the failure or material decrease of our fuel supply. To be of avail, however, such transmission must be economical, not only in the percentage of utilizable power sent through the line, but in the investment which must be made to realize it. So long as we were dependent upon the direct current, but little progress could be expected in this important problem. It has only been, therefore, in the last few years that the art was ripe for the taking up of this subject in a serious spirit, and with any hope of a real solution. The direct-current dynamo, handicapped with the commutator, is necessarily limited to supplying currents of relatively low voltage; the economic transmission of power demands the use of currents of small volume and very high pressure. This means small line conductors, and hence a relatively small investment. It means also a small loss in heating the line, since the heating power of the current varies as the square of the volume transmitted.

It is only by the alternating system of distribution that we can realize this essential condition of economy. We have here no such limit to the electrical pressure in the generating apparatus as in the direct-current system, and through the medium of the converter it becomes possible to vary the two elements of electrical energy—current volume and pressure—to suit the most widely differing applications. It is this latter feature of the system which gives it its great range and flexibility, and its consequent economic value. It enables us, for instance, to generate a current of a certain voltage at the machine, then to raise this to ten, twenty, or fifty times the original pressure for transmission through the line, and then at the far end to step down to as low a pressure as we may want—a pressure suitable for entering dwellings, offices, and shops, and safe in the hands of the consumer. These successive transformations and retransformations, it should be noted, are effected in the simplest kind of a way. They involve no machinery with moving parts, but simply coils of wire placed in such relation to each other that the currents passing in one induce similar currents in the other. The practical value of this system arose with the discovery that the induction coil, like the dynamo, is reversible. This coil had long been used to transform a current of considerable volume and low pressure into one of very great pressure and small volume. The construction which enabled this to be done consisted in making the primary coil with a few turns of stout wire; and the secondary—that on which the induced current was produced—of a great many turns of fine wire. It was presently discovered, however, that this mode of operation might be reversed, and that, by passing a high-tension current of small volume through many turns of wire, a current of large volume and low pressure could be induced in a secondary circuit of few turns, and that the pressure and volume of the induced current in relation to that of the primary one depended only on the relative number of wire turns in the two circuits. If, for instance, the primary and secondary coils contained the same number of turns, the pressure and volume of the induced current would be precisely the same as the primary one. If, on the other hand, the induced circuit contained ten times the number of coils of the primary, the current in it would have a tenth of the volume and ten times the pressure of the primary one, while if the relation of the two circuits were reversed the induced current would have its volume increased to ten times and its pressure reduced to one tenth of that flowing in the primary.

In the field of lighting this method of electric distribution has taken a leading place, and it is no longer questioned that it is destined to displace entirely all methods of direct-current supply. It has heretofore found but little application to power transmis-

sion, because it has lacked the prime requisite for such a use—a satisfactory motor. This missing link in the chain of appliances necessary to render the system complete has in recent years been supplied by the discoveries and inventions of Mr. Nikola Tesla, whose remarkable experiments with alternating currents of great tension and enormous frequencies have excited such widespread interest among scientific men. To understand the solution given to the alternating-current motor problem by Mr. Tesla it will be necessary to consider briefly the principle of the electric motor and the cause of the rotation of an armature in a magnetic field. If we take a loop of wire forming a closed circuit and place it between the poles of a magnet it will tend, when a current is flowing through it, to set itself so as to inclose the greatest number of lines of force—that is, in a plane at right angles to the line joining the magnetic poles. If the mechanical inertia of the moving loop carry it slightly past its position of equilibrium, and at the same moment the current through the loop be reversed, it will be pulled around by the attraction of the magnetic poles to a new position of equilibrium; and if at each of these positions there takes place a reversal of the current, continuous rotation of the loop will be produced. Where there are many loops, as in actual machines, the pull upon the moving system of coils tending to rotate it will be continuous and equal at all points of the rotation, as, while some coils are approaching and passing through the position of equilibrium, others are in position to have exerted upon them the maximum strain. The pull of the field magnets upon the moving conductors is greatly increased if these be wound over an iron center, as in this case each loop tends to set up magnetic poles in this core in a position at right angles to its plane. Two magnetic poles attract each other when of different polarity and repel each other when of the same polarity. The poles of the iron core are consequently repelled and attracted by the field poles with each change of the direction of the current, and this occurs in exact synchronism with the changing forces acting upon the wire circuits. It must, of course, be understood that with a continuous current the direction of the current in space is always the same. The alternating current impulses set up in the armature coils of the direct-current dynamo are through the device of the commutator made to follow each other in the same direction through the line. Arriving at the motor, these impulses pursue a continuous course through the armature always in the same direction, the positive current always flowing in by one brush and the negative out by the other. The armature coils, however, by reason of their rotation, present their two ends in succession to the positive and negative brushes, and hence are alternately traversed by the current in reverse directions. If now the commutator be suppressed

on both generator and motor, it is evident that the armature coils of the motor will be traversed by successive positive and negative electrical impulses at just the right time, if the armature rotates in unison with that of the generator, as both armatures then pass through like portions of their magnetic fields during the same current phase. If these alternating current impulses are not, however, properly timed, they will interfere with each other and the motor armature will not rotate. It is possible, then, to utilize the alternating-current dynamo as a motor, but only on the condition that it runs synchronously with the generator. Evidently it must first be brought up to the speed of the generator before the conditions are realized that will keep it in motion. As a practical motor it has therefore the fatal defect that it will not start of itself, and it has the further one that it is readily thrown out of synchronism by a slight excess of load, and is then speedily brought to a standstill.

Clearly an apparatus so sensitive as this could not be relied upon for commercial work nor expected to stand as a solution of

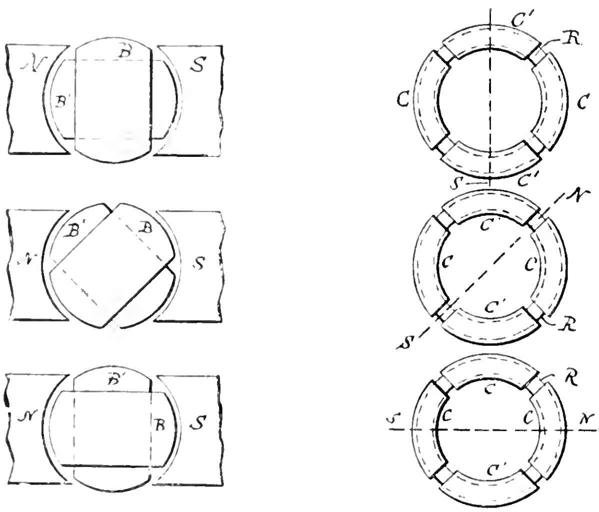


Fig. 6.—Diagram illustrating Principle of Tesla Motor.

the alternating-current motor problem. When Mr. Tesla took up the question he sought for a new principle of action and found it in what has since come to be known as the multiphase current. He conceived that by providing the armature of his generator and the field of his motor with two more sets of coils, connected so as to form distinct circuits, he would be able to produce a progressive shifting of the magnetic poles of the motor field, and thus drag around an armature capable of magnetic induction and placed within the sphere of influence of his rotating field. This

method of operation will be clearly understood from the diagrammatic sketch A (Fig. 6) and the illustration (Fig. 7) showing a diagram of the connections of the motor and generator circuits. Considering the latter first, M is the motor and G the generator. The armature A of the generator is wound with two sets of coils, B and B′, brought out through the shaft and connected with the contact rings *b b* and *b′ b′*. The field magnet of the motor consists of the iron ring R, also wound with two sets of coils, C C

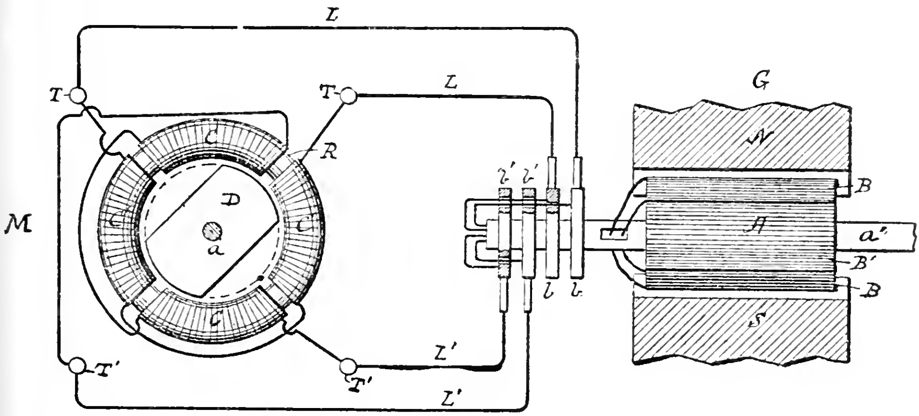


FIG. 7.—DIAGRAM OF TESLA MOTOR CONNECTIONS.

and C′ C′, the diametrically opposite coils being connected together in series. The generator coils B and the motor coils C′ C′ it will be seen are included in one circuit L, and the remaining generator coils B′ and the motor coils C C in another circuit L′. The armature of the motor consists simply of a disk of iron cut away at the sides, which becomes a magnet by induction when the motor field is energized. Turning to Fig. 6, B and B′ represent the coils of the generator armature and C and C′ those of the motor field as in Fig. 7. When the generator coils are in the position shown in the first diagram the coil B is generating no current and B′ is generating its maximum amount. The coils C of the motor field, which are included in the circuit of B′, are therefore traversed by their greatest current and produce magnetic poles in the iron ring R at N and S. As the generator armature revolves, B is brought to a position in which it is generating current, and when this movement amounts to one eighth of a revolution the circle will be in the position shown in the second diagram of the figure. Each of the pair of coils C and C′ will now tend to set up poles in the ring R of the motor ninety degrees from each other, and as their action is equal and opposite, the position of the poles will be determined by the resultant of the magnetic forces acting on the ring, and the poles will therefore be shifted around

the ring an eighth of a revolution. They will be shifted another eighth when the generator armature reaches the position shown in the last diagram, and will be successively displaced around the ring R as this armature revolves until a complete revolution has been made, when the parts are in their original position and ready to repeat the same cycle of operations.

The principle of the rotation of the magnetic poles has been applied by Mr. Tesla to a great variety of constructions. He has designed machines in which the field magnetism remains fixed and that of the armature is shifted, and others again in which there is a progressive shifting of the magnetic poles of both the field and armature in opposite directions. He has also found that the motor armature may consist of sets of closed coils, currents being developed in them by induction, and by making the induced portion of the generator stationary and the field revolving he has been able to produce apparatus free from all movable electrical contacts. In operating motors of this character Mr. Tesla usually employed a generator with multiple armature circuits as described above; but in the course of his experiments he discovered that the ordinary continuous or direct current machine could by slight alterations be made to furnish an alternating multiphase current as well as and in addition to the direct current. To accomplish this he found it was only necessary to add to the machine a pair of collector rings for each circuit of the multiphase current, and connect them with the proper armature coils. If, for instance, he desired to produce a two-phase current requiring two circuits from his generator to his motor, one circuit would include a set of coils in the armature of the generator that were passing through the position in which the maximum current was being produced, and the other a set of coils in which at the same time the minimum current was being generated. The phases of the current would then follow each other in the same order as in the previous machines with distinct circuits on the armature. With this form of machine a multiple-phase alternating current, it will be seen, can be taken off from the collector rings, while a direct current can be taken from the commutator, and a part or the whole of this direct current be sent through the field coils to energize them and then put to any use for which such currents are suitable.

This machine was later developed into what has come to be known as a rotary transformer. Instead of being driven by power it is driven by one of the forms of current which it is capable of furnishing, the other current being taken off and utilized. For example, if a multiple-phase current is passed into the machine by the collector rings it will be driven as a motor and generate direct or continuous currents. If, on the

other hand, it be supplied with direct currents, it will also run as a motor, and deliver multiphase alternating currents. This apparatus promises to hold an important place, if not an indispensable one, in any complete system of electric distribution. For many purposes, such as electroplating and electrotyping and all forms of electro-decomposition, the continuous current is essential, and for other uses, in the present state of the art, it can not well be dispensed with. One of these uses is the operation of electric railways. The alternating-current motor, though answering many of the requirements of a commercial motor, has one disadvantage in comparison with the motor driven by direct or continuous currents. It has a less powerful starting torque—that is, the pull upon the armature tending to rotate it is much less at the start than in the direct-current machine. In railway work a powerful starting torque is of the greatest importance, as a motor is frequently called upon to exert four or five times the power in starting that is needed to keep the cars in motion. Whether the direct-current motor will continue to be essential for railway work or not, it is evident that a device which enables either direct or alternating currents to be supplied to the consumer at will must add much to the flexibility and completeness of any system of distribution. With the apparatus as at present worked out it is possible to place a generating dynamo at the source of power, say a waterfall twenty miles away, produce with this multiphase alternating currents, raise the potential of these to any desired amount by means of a step-up converter, pass them through the line, and then at the distribution end reduce them through the medium of a step-down converter to any suitable pressure. These reduced currents may then be used direct for operating alternating-current motors, for running incandescent or arc lamps, and, through the medium of the rotary transformer, direct currents may be obtained for operating street railways and other continuous-current motors, both classes of lights, and all kinds of chemical decomposition apparatus. It might be supposed that the multiphase system of alternating currents was a departure away from the direction of line economy, so necessary a consideration in long-distance transmission, since this system requires two or more circuits. This, however, is not the case. It was early discovered by Mr. Tesla that the multiple circuits could have a common return wire, and it appears that the amount of copper in the combined circuits is actually less than in the single circuit required for the ordinary single-phase current.

The value of the departure in alternating apparatus made by Mr. Tesla has been very generally appreciated in the electrical world, and electric companies, both in this country and abroad,

have set themselves the task of working out complete systems of apparatus along the lines laid down by him. The Westinghouse Company, which early secured control in this country of Mr. Tesla's inventions, has developed a system using a two-phase current, while the other considerable American company, the "General Electric," has worked out a system employing a three-phase current, which form of current has also been adopted by the Allgemeine Elektricitäts Gesellschaft of Berlin. All these companies make an exhibit of this class of apparatus at the exposition, arranged to show the system in operation. The exhibits of the two chief American companies are substantially the same, differing mainly in the character of current used. Each shows the generation of multiphase currents, their transmission to the point of distribution, and their utilization in alternating and direct current apparatus.

How completely the problem of the distribution of electrical power over long distances has been solved by this system, and to what extent we may expect to see it pass into commercial use, experience alone can determine. Disregarding its future utility, when we will perforce be driven to the utilization of natural powers, and looking only to the immediate present, it is not difficult to see that its adoption will be primarily determined by the cost of operating local steam plants. Where fuel is abundant, and hence cheap, there will be little inducement to resort to sources of power at a distance, but in all situations in which this condition does not obtain, and water power is to be had within a reasonable distance, electric power transmission will find a field, and one which will constantly widen with experience. While the utilization of water powers is the most obvious use for electric power transmissions, and certainly its most immediate one, it is quite possible that it will not prove to be the only one. As is well known, a large part of the cost of coal to the consumer is the expense of hauling it from the mines. It has been often pointed out that if the coal could be burned at the pit's mouth and its energy transmitted to the place of use there might result a great saving, but any economical method of doing this has heretofore been wanting. The suggestion has many times been made to convert the coal into gas and distribute this, but the cost of piping has heretofore rendered this method of eliminating the cost of railroad carriage impracticable. It would seem, however, to be quite within the range of practical possibilities to find in electric transmission an efficient and economic method.

[*To be concluded.*]

# THE DUTY OF THE STATE TO THE INSANE.

By Dr. ANDREW MACFARLANE.

LUNACY legislation in the State of New York has been marked by two recent acts which are among the noblest monuments of the State's generosity, as well as witnesses of a scientific appreciation of the needs of the unfortunate class who are affected by them.

These acts are:

1. The change in the titles of these State institutions from lunatic asylums to that of State hospitals.

2. The State care of the chronic insane.

The first is the natural outcome of modern ideas on the subject of insanity, which is now regarded not as a manifestation of the evil one, but as a disease of the brain, affecting it in the same way as pleurisy affects the pleura or peritonitis the peritoneum, and that those suffering from mental disease should be treated not as criminals or dangerous madmen but as very sick people.

The second is a grand philanthropic work, proving that the State cares for even the most unfortunate of her children, and seeks to soften as much as possible their sad lot.

The time is fortunately past when these measures required advocates, and to-day it is necessary to keep in view only what are the best means for carrying to a successful issue both of these measures, and to consider if in any way the one tends to render the other less successful.

The fact that it is thought the saddest affliction which can befall mankind, that it affects all grades of society, that three out of every thousand are its victims, makes the consideration of the care of the insane, from the purely scientific, the philanthropic, or the economic standpoint, a subject worthy of the most serious thought and of the deepest interest to all. To-day (May, 1893) there are in the State of New York 17,814 insane patients under legal certificates of commitment in thirty-two public or private asylums, whose buildings and equipments have cost $17,500,000, where 2,900 people are employed, and which are maintained at an annual cost of $3,500,000.

This huge creation is the work of less than fifty years, for in 1843 the Utica Asylum, the first State institution for the insane, was opened for the reception of patients. Bloomingdale Asylum, a private institution, had, however, been in successful operation for many years, and was then in receipt of an annual grant from the State, and the asylum on Blackwell's Island began in 1842 to care for the insane in New York city.

The erection of the Utica Asylum marked the first decided step

in the humanitarian care of the insane by the State and the recognition of the obligation of the State to these unfortunates. It was designed that the Utica Asylum should receive all the recent cases of insanity. Those who, after a period of treatment, were deemed incurable were to be returned to the county houses, thus making room for all the recent cases. This condition lasted until 1865, when public opinion, shocked and horrified by the treatment in almshouses of the chronic insane, who then numbered 1,300, demanded that these, the most wretched of all God's creatures, should receive at least kindly care. The Willard Asylum was therefore established in 1865 for the care of the chronic insane, who were to be there maintained at the lowest rate conformable with a plain, simple diet and humane care. All the counties were required to send their chronic insane to the Willard Asylum except those which furnished suitable maintenance for them. Twenty counties, largely because of inadequacy of accommodations in State institutions, were accordingly temporarily exempted from the operation of this act. The State, however, continued to build State asylums: at Poughkeepsie in 1870; at Middletown in 1874; at Buffalo in 1880; at Binghamton, the State Inebriate Asylum, first used as a State asylum, in 1879; and the St. Lawrence Asylum in 1890.

The State asylum for insane criminals, formerly at Auburn, now at Matteawan, has not been considered in the following statistics, as the conditions there, on account of the character of the patients, are peculiar to itself and different from the other State hospitals.

The same general principle was carried into effect in their design—that is, the Utica, Poughkeepsie, Buffalo, and Middletown asylums were for the recent cases, while the chronic incurable cases were sent to the Willard and Binghamton asylums. The reason for this was the recognition of the difference in the requirements of these two classes of patients—the acute and the chronic insane. The acute insane are often dangerously sick, and should receive all the strictly medical care and attention which the character of their mental disease demands, the custodial supervision being here entirely secondary and kept as much as possible in the background. The chronic insane are incapable of living at home, and almost no hope of their recovery is entertained. These require custodial care, with incidental medical supervision. Their care is purely a question of sociology, of interest to the philanthropist rather than the physician. The supervising spirit, however, must always be medical, as only a scientifically trained mind can properly appreciate the influence of surroundings on their welfare, and can wisely and humanely classify them as their mental condition gradually changes.

This difference, too, is most strikingly shown by the fact that the average weekly cost per patient in the acute asylums was $5.29, while in the Willard and Binghamton asylums for the chronic insane it was less than half that amount, or about $2.60. The ratio of physicians to patients in the acute asylums was 1 to 110, while in the chronic asylums it was 1 to 272. The recovery rate on average daily population was twenty per cent in the acute asylums, while in the chronic it was two per cent. The average recovery rate on admissions was about thirty-three per cent in acute asylums and about five per cent in chronic asylums.*

In spite of the fact that the State had built many new asylums, the number of insane patients in the State increased more rapidly than the accommodations provided for them. The counties also found it more economical to abuse, under the guise of care, many of their own chronic insane. The result, therefore, was that the number of these unfortunates in county houses had in 1889 increased to 2,200. Their condition was most pitiable, and the recital of what they were subjected to carries one back to the barbarities practiced in the middle ages and by savage tribes. The Charities Aid Association, President Craig of the State Board of Charities, and Dr. Stephen Smith, then State Commissioner in Lunacy, kept for three years nobly at the work of making public this disgrace and blot on our civilization. Finally, in 1890, the present State care act, the consummation of their endeavors and those of the present commission in lunacy created in 1889, became a law. This State care act calls for the removal of all the insane patients from county houses to State hospitals and their care therein. New York and Kings (Brooklyn) Counties are exempted from this act, as they are considered to furnish suitable accommodations distinct from their poorhouses for their insane. The State has been divided into districts, and each hospital has its own district, from which it draws all the patients, both acute and chronic, thus making all the State hospitals of the same character—that is, mixed hospitals for the care of both the acute and chronic insane, instead of hospitals for the acute cases and asylums for the chronic incurable cases.

In order to furnish accommodations for this large increase to the State hospital population, it has been designed and is now being carried out to erect cheap buildings as annexes to the present State hospitals on the hospital grounds at a cost of $550 per patient. These buildings are intended for the more easily managed chronic cases, and will enable the State to care for the 2,200 insane patients who were inmates of county houses before this

* Many of the recoveries in chronic asylums were of acute cases of insanity in persons living in the immediate vicinity of the asylum.

act went into effect. Each hospital is allowed $4.25 per week for the first three years of residence of each patient, and $2.50 per week for any period beyond three years. It is also intended that one assistant physician should be assigned to every two hundred patients.

The thought now arises, What kind of medical care do insane patients require, and what has and will be the effect of this huge influx of chronic incurable insane upon the true object of a State hospital, the cure of the insane?

The demand for and the recognition of the need of a more distinctively medical care for the insane is shown by the change in the titles of institutions for the insane from asylums, a place of refuge, to hospital, a place of cure; a movement which is so general as not to be due to any local cause or influence, and also in the recent pleas of some prominent alienists that the acute insane should receive the same kind of medical care as patients suffering from any other acute ailment. The latter go so far as to advise the establishment of a hospital for the acute insane on the same lines as those of any general hospital,* with its visiting staff and thorough attention to all physical disorders in addition to the mental disease.

To-day the solution of this question lies either in a general hospital for the acute insane or in the hospitalizing of the old asylum or part of it. A general hospital for the acute insane would not, I believe, be advisable, and could not be properly conducted except in the large centers of population where there are many specialists in insanity. The duration of the illness, the need at certain stages of the disease of diversion or occupation, because there comes a time when such influences are most powerful for good, the difficulty of determining at once whether the disease is curable or not, thus tending to overcrowd such an institution or necessitating frequent changes; all these would make impracticable such an institution. Then, too, the fact that in our present State hospitals most of the patients come from small cities or the country, where there are poor or no hospital facilities and certainly no specialists, would necessitate the erection of many special small hospitals in these places or the transference of these patients to large cities with all the attendant ill effects—noise, excitement, and close quarters.

But that acute cases of insanity, however, need some kind of hospital treatment is evident. No less an authority than Dr. J. Batty Tuke has thus written: "The subjects of most of the insani-

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* By general hospital in this connection is meant a hospital constructed on the same lines as other hospitals for special diseases or the establishment of special wards in a large general hospital.

ties are very sick people indeed, for, in the first place, they are in danger of their lives; and, in a second, they are in imminent danger of lapsing into that living death, terminal dementia. Each case, under circumstances of curative rest and calm, requires special hospital treatment, conducted on identically the same principles as those that regulate practice in our general infirmaries, and conducted under similar conditions as regards rest, nursing, and therapeutic agents. The existing system of asylum structure, management, and treatment makes this almost unattainable. No class of cases requires the attention of trained nurses more than subjects of recent insanity."

Can the present State hospitals provide such accommodations and give such care as Dr. Tuke claims the acute insane for their proper treatment need? I believe they can, and also that the accommodation and care there provided could be made far better than any that might be furnished in an institution established exclusively on the lines of a general hospital.

Unfortunately, Dr. Tuke's charge that "the existing system of asylum structure, management, and treatment makes the medical care of the insane almost unattainable," is alas too true. The erection of palatial buildings, which would be grand and magnificent monuments to an architect's skill, a State's pride, or a physician's ambition, has too often predominated over modest, simple structures, which could be rendered homelike and natural to the inmates. The fact is that though millions of dollars have been appropriated for the care of the insane, and thousands of capable men have spent their lives in this line of work, very little has been discovered in America about the real nature of insanity, and to-day the whole subject is a *terra incognita* whose shores have scarcely been touched, and which furnishes a number of the most difficult but yet the most intensely interesting problems to be solved. This condition is the result not of a want of ability or investigating spirit among asylum physicians, but is the natural outcome of a system which so handicaps them with extraneous duties as to render long-continued original medical work almost impossible.

A physician has under his care on the average more than two hundred patients, both acute and chronic. The desire to get as many of these as possible engaged in suitable occupation, the wish to make the unhappy lot of the chronic insane a little brighter by entertainments of various kinds, the routine history-writing, the correspondence, the attention to the visits of the friends of this large number of patients—all of which, needful and necessary in their way, make so many demands on the physician's time that medical work becomes necessarily secondary and the administrative duties the more important work.

Though legislative enactment has made all asylums hospitals in name, it has not accomplished this in fact. To-day the tendency of the State care act, though noble and generous in its inception, has been to make the hospital treatment of the curable insane almost impossible, or at least most difficult. It has crowded all the State hospitals with a mass of patients for whom nothing medically can be done, thus essentially interfering with proper classification. It compels the placing of recent, curable, maniacal, and suicidal cases with old chronic patients who are violent, destructive, and filled with all kinds of delusions of persecution and various hallucinations. These tend not only to strengthen the newcomers in their own morbid ideas, but to implant many new ones. Their influence on the terrified, depressed, and deluded is especially pernicious. It is not necessary to paint a word-picture of the sad effect of such surroundings on these sufferers. Every asylum physician has been deeply touched by the descriptions by recovered patients of the shock upon them on admission of their surroundings; the shouts of their neighbors, the indescribable fear of other patients, the frightful thought, "This will be my fate," the baneful remarks of mischievous patients present in every institution who, with show of sympathy, say to the hypersensitive newcomer, "Such a one has been detained here these many years, and doubtless you will be."

These are not argument-made examples, but exist in every State hospital. They not only influence temporarily the imagination, but often do irremediable damage to the mind. The Pennsylvania State Lunacy Report, in considering this subject, says: "The acute are often heard to allude with horror to the condition of the chronic patients, dwelling most painfully upon the imminent probability of soon becoming hopelessly lost to home, friends, and society, and of passing the remainder of their lives in similar seclusion. Like begets like, and as the population of any hospital for the insane is chiefly chronic, there being relatively only a limited number of acute cases scattered through the various wards, this evil association must rob society of many a useful and productive citizen by placing him in daily contact with those who mar his chances for recovery." These are the mental and moral effects of such intercourse.

The chronic insane by the mere force of numbers also influence too much the character of the management of a State hospital and turn it from its true work, the cure of the insane. They constitute more than nine tenths of the entire number of patients in every mixed asylum, and receive more attention and care than the character of their condition demands, thus depriving the curable insane, who are less than one tenth the number, of much of what the hopefulness and acuteness of their sickness needs and requires.

In justice, it must be said that every asylum physician seeks to give the acute cases the larger part of his time, but the press of other matters, non-medical, so encroach upon his time that he usually finds that he has neglected, or at least has not done as much for them as he might have accomplished under *other circumstances.* What, then, are these *other circumstances,* and how can a State hospital take better care of acute cases than a general hospital?

Let us take, for example, a State hospital of one thousand patients. The staff would consist of a medical superintendent, five assistant physicians, and a woman physician. In a hospital of that capacity there would never be more than one hundred patients who would be considered curable, and the number would probably not exceed sixty. More than nine hundred patients would be hopelessly incurable, for the most part the wrecks of past disease, who practically need nothing but kindly custodial care with incidental medical treatment. Two, or at most three, physicians could easily do all that a humanitarian spirit might deem necessary for such a number of this class of patients. Three or four physicians would thus be left to devote themselves to the curable patients. Instead of constructing annexes for the harmless patients, let these be lodged and cared for in the huge barracks-like main buildings, the creation and legacy of a former generation. Then erect at suitable distances from the main building three or four houses for the treatment of the curable patients. These should be built simply and comfortably, so constructed as to do away with the huge institutional feeling and to give them a homelike appearance, and so furnished as to take away as much as possible all indications of confinement and restraint. They should contain no wards, but plainly furnished single rooms with sitting-rooms, thus permitting the utmost privacy, with the opportunity of intercourse when deemed beneficial.

Here the real medical work of the hospital should be done, and no labor should be spared which would in any way tend to the recovery of a patient or help to solve any of the unknown problems of insanity.

Electricity, massage, baths of all kinds, thorough examination of the blood and the various excretions, the use of the sphygmograph and ophthalmoscope, together with a very thorough physical examination would easily and most profitably keep employed the number of physicians assigned to the acute cases. For it is in this acute and presumably curable period that the case should have everything that medical skill and unremitting attention under the most favorable circumstances can confer. The disease must be arrested in this beginning stage if it be in our power to arrest it.

The nurses, too, should be especially selected for this service among the curable insane. Those who have, by work among the chronic insane, shown that they possess the aptitude and tact necessary to care intelligently for such patients could easily be selected for this special work. Then with these nurses could be placed several nurses who have had general hospital training and who would therefore be more apt to regard insane patients from the purely medical side. The number of nurses, too, should depend upon the need of each case; if necessary, a single nurse should be assigned to a patient, though this, probably, would rarely be required. The criterion, however, should be, What will be most helpful in a curative way to the patient? The nurses would thus feel the great importance of the work they were doing, because every case would be considered as a curable case, and there is no greater incentive to good work than the feeling that the work is of great value. By a slight increase in the wages in addition to the importance attached to the work, the very best nurses employed in the hospital could be secured for this work, and easily made most enthusiastic about it. The effect also upon the medical staff would be most beneficial. Any one who has seen the tendency to the undermining of the medical spirit in talented, brilliant, and ambitious physicians who have accepted State hospital positions, will appreciate the importance of anything that would increase the medical spirit in State hospitals.

In a discussion before the British Medico-Psychological Society on the subject How can the medical spirit best be kept up in asylums for the insane? the following means were most strongly dwelt upon:

1. Classification—that is, separation of the curable from the incurable asylum population.

2. Necessity for hospital treatment for the curable.

3. Necessity for training the attendants.

4. Necessity for more physicians to asylums, and a rearrangement of their duties.

Such purely medical treatment of the curable insane can be best carried out in annexes to the present State hospitals and under the same management. The State in each State hospital has a most valuable plant, with large, handsome grounds, conveniently situated to the section of country from which it receives its patients. They are in charge of well-equipped and competent medical officers who have given their lives to this work, and especially appreciate the needs of this class of patients. Then, too, there is the body of trained nurses from whom the special nurses could be selected. There are also in existence various industries and means of amusement, which, though hurtful in certain stages for some, might be and are used with great advantage in the con-

valescing period when the acute insane are not so susceptible to morbid influences. But most important, because of the difficulty of determining at once in some cases the curability of the disease, is the possibility of keeping under observation doubtful cases until the character of their disease can be determined and they can be correctly classified. Transferences from the chronic to the acute buildings could also easily be made if any supposed chronic case should manifest signs of mental improvement.

The State has always recognized the principle that curable patients required more and better care and attention than the chronic cases. This was formerly shown by the greater sums per patient given to the hospitals for the acute insane. The same fact underlies the present allowance of $4.25 per week for the first three years of hospital residence, the presumably curable period, and $2.50 per week for the remaining time, when the patient would be regarded as chronic. This is an exceedingly poor, though probably under the circumstances the best, way to meet this problem, the difference in the character of the care required by the curable and the chronic patients. Only sixty per cent of the admissions are curable cases; the others can be diagnosed as incurable at the first meeting, and require only the simple care which chronic patients should receive. As the hospitals are now constituted, the acute cases are placed among the chronic, and of necessity can receive little more than the average care of the hospital. We have here a double injustice: first, greater sums are given for some patients (those whose recovery is hopeless from admission) than the character of care for their disease demands; second, many (those who are curable at admission) do not receive the extra care which their illness demands, and to which the increased sum ($4.25) entitles them. It practically means, therefore, that the increased sums received from the recent cases go to elevate the general standard of care of all the patients rather than to be expended exclusively on the acute cases for whom this increased amount is given. Thus the chronic cases get more care than it was designed that they should have, or than they really need, and the acute patients are deprived of the better care and attention which it was intended they should receive.

"The duty of the State is such provision as to accomplish the largest result in the restoration to health of curable cases, the element of expense being here a subordinate one, and for the remainder such comfortable provision as shall insure safety to the community and humane care to the sufferer." *

* Address of Dr. W. W. Godding, Superintendent of the Government Hospital for the Insane, Washington, D. C., read before the National Conference of Charities and Corrections, September 16, 1889.

The medical superintendent could determine on the admission of patients which were incurable and which gave hope of cure. The State should then appropriate such moderate sum per person for all incurable patients, whether of recent admission or of long-standing disease, as to enable these sufferers to receive kindly care and a few of the pleasures of life. For the curable cases in the hospital annexes no reasonable expense should be spared. This is true economy regarded either from the philanthropic, economic, or scientific point of view. The curable patients come entirely from the strong people who have earned their own livelihood, and have done their part in the world until, loaded down by ill-health, trouble, or care, they break down and go to a State hospital for treatment. The mental weaklings, the victims of the degeneracy of their ancestors, the last step before the extinction in them of the species—these, who have always been a burden on the community, are all to be found in the incurable class.

It has been estimated that the average duration of life of a chronic insane person is twelve years. This represents in money expended for care and in lost productiveness about five thousand dollars. The economic importance, therefore, of saving every patient possible from lapsing into chronic insanity becomes apparent. It is reasonable also to suppose that with such hospital care the duration of sickness in curable cases would be lessened, and that many would more quickly resume their former occupations.

The moral effect, too, upon the general public would be marvelous, and the strictly medical aspect of insanity would be appreciated by the lay mind. It is an accepted scientific fact that insanity, in curable cases, is curable directly in proportion to its early medical treatment away from home associations. The public, when the character of the hospital annex for recent cases and the importance of early treatment were understood, would not regard a State hospital as a place of living death, only to be resorted to when all other means fail, and often after all hope of recovery or possibility of accomplishing any curative measure is past.

The cost per patient in the hospital annex would not be more than is now expended in any good general hospital, and would not exceed nine or ten dollars per week for such patient. Such a method would not be any more expensive than the present system, and when the permanent effects are considered would give the best results and would also be a positive saving. The average weekly cost under the present conditions per patient is three dollars and a half, or $3,500 for a State hospital of one thousand patients. Under the separate plan of treatment, the curable patients, numbering not more that eighty, could be maintained at a weekly cost of ten dollars per patient, or $800; the nine hundred and

twenty chronic incurable patients could be humanely and kindly cared for at three dollars per week for each person, or $2,760, thus making the total cost of treatment, under probably the best conditions, $3,560.

This mode of treatment of the insane, far from being Utopian, is at present in successful operation in Strasburg and Heidelberg, and is about to be carried into effect in some of the Scotch asylums. The most eminent alienists in Great Britain and America have strongly advocated it.

Lord Shaftesbury, before a select committee of the House of Commons in 1887, thus explained the intention of the promoters of the early lunacy laws: "The asylum was to be divided into two; there was to be the principal asylum, which was for the acute cases; and there was to be a chronic asylum alongside of it, which was for old, chronic, incurable cases. All the recent cases were to be sent to the principal asylum, which was to have a full medical staff, and everything which could be necessary for treatment and cure."

Dr. J. Wigglesworth, superintendent of an English asylum, in the discussion on The Future Provision for the Chronic Insane before the British Medico-Psychological Society, said: "A more important question than the care of the chronic insane was whether they could not make a more determined effort to do more for the cure of the recent cases. To do this they must hospitalize asylums more. They must have small buildings properly officered and equipped, to which all recent cases should first be sent. The increased knowledge thus obtained would without doubt in time bring about an increase of the recovery rate."

Dr. H. Hayes Newington, in his presidential address delivered at the annual meeting of the Medico-Psychological Society of Great Britain in 1890, advocated the hospital annex for curable cases within easy distance of the main building. He stated that, in a hospital of one thousand patients, not more than sixty on an average would need such treatment.

Dr. D. Hack Tuke, in discussing the above address, said: "There should be means of treating acute cases in a separate hospital block, one in the construction of which no reasonable expense should be spared; or there should be a hospital at some distance from the asylum, on the lines laid down by Dr. Newington."

Dr. E. B. Whitcomb, in his presidential address before the British Medico-Psychological Society in 1891, stated: "The hospital treatment of the acute insane would insure the separation of acute from chronic insanity, sustain and encourage the more rational treatment of insanity as a symptom of physical derangement; but above these a well-constituted hospital would be the means of promoting to a greater extent and in a more elab-

orate manner than at present exists a scientific and wider knowledge of the disease. Such a hospital should be administered on the most liberal principles, not as you see at the present time in a competing spirit as to the smallest cost, but having a due regard to frugality in its truest and most economical aspect—the cure of the insane."

Mr. William P. Letchworth, formerly President of the New York State Board of Charities, in a scholarly and careful *résumé* in his admirable work, The Insane in Foreign Countries, advocates thorough remedial measures in small hospitals, no matter how expensive, for the acute insane, as not only more humane, but in the end more economical.

Dr. Chapin, Superintendent of the Pennsylvania Hospital for the Insane, in his presidential address before the superintendents of institutions for the insane, said: "Every hospital should have a special organization for the medical treatment of its recent curable cases. Is it the better way to continue our recent cases in the wards of large hospitals in constant contact with hundreds of chronics? To this serious and important interrogatory I must enter an emphatic negative answer, and believe it is not too soon to sound a note of warning. The needs of the recent and acute cases may be best met by the erection in connection with our State asylums of small and well-appointed hospital wards for the strictly medical treatment of such cases."

The late Dr. Bancroft, Superintendent of the New Hampshire State Asylum, thus wrote on this subject: "I have little doubt that moderate-sized hospitals constituted and operated either independently or as annexes would return increased ratios of recovery while adding vastly to the comfort and happiness of patients during hospital residence. Such adjustment would diminish routine, secure the largest degree of personal freedom and indulgence, and guarantee to each individual the best remedial influences as well as protection from such as are both distasteful and detrimental."

Dr. Godding, in an address before the National Conference of Charities and Corrections, thus spoke on this question: "The provision, then, should include one building, or preferably one group of buildings, designed especially for the acute and curable cases. No detail in construction should be omitted, no liberality of arrangement curtailed, that may be held to in any way assist in the treatment and cure of these cases."

The last fifty years have witnessed a work of which we have reason to be proud: the evolution of the care and treatment of the insane out of the mist and darkness of superstition and ignorance, when the insane were chained, beaten, and burned, to the present kindly care which seeks to treat them as very sick people. The

future, however, presents also a grand work to be accomplished: the elevation of this specialty to the highest scientific and philanthropic plane.

The duty of the State to the insane may, therefore, be summed up in—

1. The separate treatment of the curable and incurable insane under the same medical executive.

2. True hospital treatment for the curable insane with all the medical skill, nursing, and care, regardless of expense, which the character of the disease demands.

3. Simple, humane, custodial care of the incurable insane, at a moderate expense.

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## THE LIP AND EAR ORNAMENTS OF THE BOTOCUDUS.

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THE Botocudus are a rapidly disappearing tribe of Brazilian Indians. They inhabit the country along the upper portion of the Rio Doce, about three hundred miles northeast of Rio de Janeiro, and the region lying along the borders of the States of Bahia, Espirito Santo, and Minas Geraes, especially between the Rio Doce and Rio Pardo, and along the Sierra dos Aymorés. Although they are now in contact with civilization and fast yielding to and dying out before its gentle influences, it is not many years since they and the various branches of their great family occupied a large portion of southern Brazil, and were justly looked upon as the most ferocious of all the wild tribes of that country. But few travelers have seen anything of them, and these have observed only the straggling outskirts as it were of their tribe. Even to this day the latest and best maps of Brazil have written broadly across the vast region referred to, "But little known, and inhabited by Indians." In these dense and almost impenetrable forests they spend their lives, seldom or never visiting either the *campos* of the interior or the coast.

To judge of the stage of civilization of these Indians it is worth while knowing that they can not count, and that their reckoning is done by using the fingers and toes, and that even this does not go beyond twenty. The children are dirt-eaters, and are sold for slaves, often for the merest trifles. Formerly these people wore no clothing at all; nowadays they are coming more and more to use it. Their straight, deep black hair, high cheekbones, flat noses, complexion, and stature are all suggestive of the Mongolian race types.

It is not my purpose, however, to say much of the Botocudus

except with reference to their custom of wearing the large and broad lip and ear ornaments shown in the accompanying illustrations. Several travelers in Brazil have given figures of Indians using such ornaments, notably Spix and Von Martius, Maximilien Wied-Neuwied, Hartt, Jean de Lery, Bigg-Wither, and Von Tschudi. It may be said of the illustrations given by those writers, however, that they, without exception, fail to give the characteristic features and expressions of the Botocudus, or, for that matter, of any Indians. Those used in the present article, on the other hand, have been carefully drawn from photographs made a few years ago by M. Marc Ferrez, photographer to the Imperial Geological Survey of Brazil, and may be relied upon for their accuracy. The subjects chosen for the photographs were selected with a view to securing the best types that could be had, but it should be remembered that the Botocudus of to-day are rapidly approaching extinction, and that their customs are probably modified to a considerable extent since the visit of Spix and Von Martius, which was made in 1817 to 1820.*

Fig. 1.—Botocudu Woman. The flesh band of the lip has been broken and the ends tied together with a piece of bark, that the lip ornament may be used. An opening has been made in the ear lobe, but it is not of the customary size.

The custom of wearing the lip and ear ornaments is a very ancient one among the Botocudus, for the earliest travelers found it in vogue when the continent was discovered. Hans Stade, who lived among the Ay-

Fig. 2.—Botocudu Woman, with both lip and ear ornaments of average size.

* Rum has much to do with the wiping out of the native Indians of Brazil. The whites, especially the original settlers of the country, treated them without pity, enslaving them and killing them upon the slightest provocation or with no provocation whatever.

morés of southern Brazil in 1549, says of one of the chiefs, "Then he arose, and strutted before me with proud conceit, and he had a large round green stone sticking through the lips of his mouth as their custom is." *

The opening in the lower lip is made when the person is quite young by piercing it with a long, slender thorn that grows on a kind of palm tree; this is enlarged with the point of a deer's horn, and a stick or small stone is inserted and the wound is greased with some kind of salve. These openings are gradually enlarged by forcing bigger and bigger plugs into them until the desired size is reached. It was formerly the custom when the young men were old enough to bear arms that the openings were enlarged and the green stone labrets inserted.†

Jean de Lery says that sometimes when these stones are out, just for the fun of it, they stick their tongues through the holes in their lips, to make people believe they have two mouths. He adds, "I leave you to judge whether they look handsome when they are doing this." ‡

Fig. 3.—Botocudu Man. The ear ornament has been removed and the distended lobe is allowed to hang free.

The lip ornament is of two very different forms, only one of which—the broad and stopper-shaped one—is illustrated in the accompanying cuts; the other is long and rudely T-shaped. The shank or long cylinder is pushed through the opening from inside the lip and the cross-piece at the top prevents its falling out. The openings for ornaments of this kind are not nearly so large as those required by the stopper-shaped ones. Several writers tell of the use of stones for labrets. Jean de Lery # speaks of polished bone as white as ivory used by the big boys, and replaced when they are grown by green stones. I have seen many of them made of clay and burned like pottery, while the ornaments in most common use nowadays are made of wood.

There is a fair collection of Brazilian Indian lip and ear orna-

* The Captivity of Hans Stade, of Hesse. The Hakluyt Society, No. li, p. 72.

† Hans Stade, p. 139.

‡ Histoire d'vn Voyage faict en la Terre dv Bresil, par Iean de Lery. Geneva, 1583, p. 104.

# *Op. cit.*, p. 104.

ments in the Museu Nacional at Rio de Janeiro. Many of the examples in the collection are beautifully finished specimens of jade, beryl, serpentine, and quartz, while others are but rudely shaped ones of burned clay and wood.

However strange and in a certain sense fascinating such customs may be, these ornaments, when seen in the ghastly wounds of the dusky, stolid faces of savages, are inexpressibly hideous. They are rendered still more so by the fact that the South American Indians, so far at least as my observations go, lose their front teeth early, and especially the lower ones, and the pulling down of the lower lip almost invariably exposes the toothless gums or the broken, decaying, discolored, and filthy teeth. Hunger is the curse of savage life, and the savage is therefore always on the alert for something to eat. For this reason the discharge of saliva is much more marked with a savage than with a civilized man. The effect of this free discharge of saliva on the personal appearance of a man or woman, whose lower lip is all the time drawn so low that it can not be retained, may be imagined more readily than described.

Fig. 4.—Botocudo Woman. The ear ornament has been lost and the distended lobe is looped above the ear.

The stopper-shaped lip ornaments are now made of some light kind of wood. They are usually about three quarters of an inch thick and two inches in diameter, though sometimes they are much larger. Prince Maximilian measured one four inches across. Around the outside of the plug a little groove is cut, and when it is inserted the flesh band of the lip fits in this groove and thus holds the plug in place. With age the flesh bands relax considerably, and the plugs of old persons are for this reason generally larger than those of younger ones. When the ornament is removed the lip dangles in a most ungraceful manner. In the accidents of savage life these openings in the lips are often broken, but this does not prevent the wearing of the customary ornament, for the broken ends of the band are united by a string made of a bit of bark, and the plug thus held in place. One of the accompanying illus-

trations (Fig. 1) was made to show this method of sticking to the fashion.

The ear ornaments of the Botocudus are not essentially different from those used in the lips (see Fig. 2). The plugs are of the same materials, size, and appearance; they differ only in that they are worn in the openings made in the lobes of the ears instead of in the lower lip. The bands of the ears, when the plugs are not in place, dangle upon the shoulders when left to themselves (Fig. 3), but they are generally thrown over the top of the ear. This custom of looping up the ear lobes is shown in Fig. 4.

Fig. 5.—Young Botocudu Woman, Age about Seventeen. The ornaments worn in the ears are the modern pendants.

Many persons who have seen these pictures have thought such a fashion too inconvenient to last long. But the inconvenience of a fashion seems to have but little or nothing to do with either its origin or its perpetuity. Our own fashions are often complained of as tyrannical, unreasonable, unbecoming, inartistic, useless, whimsical, and everything else that is not downright wicked. But all people have fashions of one sort or another, and we can only congratulate ourselves that, however bad some of our fashions may be, they might have been worse than they are.

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Among the reasons published by Count Paul von Hönsbröch, of Germany, for renouncing his allegiance to the order of the Jesuits, are the rigor and monotony of the discipline enforced by its rules. From the first day of his novitiate the young Jesuit, it might be said, is run into a mold from which he is ultimately to emerge a mere passive instrument of the mission work of the order. The mesmerized or hypnotized patient, according to the count, is not a more perfect tool in the hands of the manipulator than is the well trained Jesuit in those of the general of the order. He lives, moves, and has his being simply at the behest of his superior, and responds to the demands from those above him with a fidelity and an efficiency attainable under no other system. A similar confession is made by Count Campello, of Rome, in his statement of reasons for having ceased to serve as canon of St. Peter's. The daily monotonous exercises of the Basilica, repeated morning and evening without break from year to year, were paralyzing his mental and bodily powers and destroying all initiative. These facts point to a fatal influence of monotony which deserves to be studied; for under the increasing specialization of learning and occupation, life is tending daily to become more monotonous and more destitute of true inspiration.

# CRIMINAL FESTIVALS.

By M. GUILLAUME FERRERO.

WHAT we now call crime is a normal fact of social life among ruder peoples, who have not yet risen above the lowest grades of manhood. Murder, theft, pillage, are glorious exploits or rarely sought-out amusements among such; and cannibalism is a system of alimentation more prized than all others. Primitive man in most regions has no repugnance against killing and eating other men, but rather finds enjoyment in it. This being the moral condition of most primitive peoples, we can comprehend without difficulty that their festivals had a cruel and criminal character. As human flesh is the most exquisite viand for cannibal savages, it was natural that when they met to celebrate any welcome event in a festal way they should regale themselves liberally with this precious food. The Fijians never failed in their cannibal days to mark every public solemnity, like the dedication of a temple, with a grand feast of human flesh: and they celebrated their victories in war by carving and roasting their slain enemies on the field of battle. The Monbuttos celebrate grand man-eating festivals on the field of battle after a victory. The New-Zealanders carved up immediately after the battle their vanquished and wounded enemies, while prisoners were reserved, partly to be eaten by the braves, and partly for grand public festivals in which human flesh was the principal dish.

Murder is a pleasure to the primitive man, as with the Javanese, who tests the quality of his new dirk by plunging it into the heart of the first man he meets. It is quite natural, therefore, that there should be meetings among these people for the enjoyment of this pleasure, at which they engage in murderous festivities at the expense of some unfortunate victim. The red Indians, returning from an expedition, used to give themselves up to sanguinary orgies upon their prisoners, binding them to a stake in the midst of the village, when men, women, and children would inflict petty tortures upon them till they died, killed by pin-prickings.

We see, then, that in the beginning of civilization crime is individual and collective; there are crimes which each man commits on his own account, and criminal festivals, collective crimes, perpetrated by a whole tribe, a people, etc.

The same rule prevails with those very numerous crimes which are connected with religious ideas, such as human sacrifices in honor of defunct ancestors and then of the gods, who are only deified ancestors. Among so savage peoples, these ancestors would have been fierce and cruel men, to whom human sacrifices, kill-

ings, and massacres would be supposed by their adorers to be pleasing; in fact, the Tahitians believed that their god Oro was very well satisfied when wars were bloody; and the Chibchas said that no sacrifice was so dear to the gods as sacrifices of human blood. For this reason many were killed among the most savage peoples in honor of ancestors and the gods. These religious crimes, too, were individual and collective—that is, the sacrifice was sometimes performed by one man, sometimes by a family, and sometimes by a whole tribe, according as a personal, a family, or a tribal concern was to be commended to the gods.

According to this view, we should be tempted to believe that when crime began to be the object of legal repression and moral repulsion, all these individual and collective crimes, festivals, and human sacrifices would disappear. It is not so. By a curious contradiction, individual crime has disappeared sooner than collective crime. The branding by the public opinion of peoples who have become sufficiently civilized, of murder, theft, and cannibalism as offenses, may have prevented individuals from committing them, but did not prevent the whole people celebrating the criminal festivals which their savage customs had engendered, although they were contradictory of the changed condition of public morality. In fact, we find among very civilized peoples official festivals and ceremonies which are wholly worthy of the most savage races.

It is a general belief among primitive peoples that human blood, possessing marvelous qualities, assures fertility to the fields and stability to houses, and on that account a large number of homicides are committed among such peoples: for each man tries to assure the benefits of bloodshed to his own fields or to his house. Among the civilized Aryans of India this barbarous custom existed no longer; whoever killed a man to use his blood for such a purpose would have been condemned as a murderer; but the ancient usage still survived in public ceremonies.

War is often made by primitive peoples for the purpose of eating the enemy who is slain, for the enemy is then only a special kind of game. With some peoples who have advanced a little, and who have abolished their cannibalistic customs, we find that human flesh is the essential dish in certain banquets celebrated in honor of victories. In Dahomey, after fortunate wars, there were public festivals in which banquets of human flesh were a sacred custom, although the Dahomeyans were not cannibals; and it was the king's function to eat the heart of an enemy's chief slain in war.

What is called *juridical* anthropophagy occasionally gives rise to a peculiar species of criminal festivals. Among the Battas of Sumatra, a numerous people, agricultural, peaceful, and law-

abiding, who have a regular system of laws, an alphabet and a literature, and are not cannibals, the adulterer, the night-robber, and those who traitorously attacked a city or a village, were condemned to be eaten by the people. They were tied to three stakes, their arms and legs stretched out to form a cross, and then, at a given signal, all those present would rush up to them and hack them up with hatchets and knives, or simply with their nails and teeth. The torn-off pieces of flesh were eaten at once, raw and bleeding, being first only dipped in a mixture composed of citron-juice, salt, etc., prepared in advance in a cocoanut shell. In adultery cases the husband had the right to choose the first piece.*

The Dyaks have a criminal festival associated with the peculiar custom of head-hunting. Since in many tribes a young man can not marry till he has presented a human head to his sweetheart, he hides himself in the shrubbery of the jungles and watches for his victim for days at a time, till he kills him and cuts off his head. Then he returns to his village and announces his triumph by blowing upon the sea-shell that serves him as a hunting horn; the children and the women come out to meet him, give him an ovation, and lavish upon him the most exaggerated and hyperbolical praises; and the bleeding head is borne in great pomp to the house of the chief. Before hanging it up in front of the dwelling, children are caused to suck its blood, in order that they may draw courage from it. Yet the Dyaks are a peaceful people, for homicide is very rare within their tribes. "Not the thirst for carnage, or the love of murder," writes Temmink, "or any spirit of vengeance, induces them to cut off heads. They are not anthropophagic. A hereditary superstition, passed into a custom, causes them to commit acts which they believe to be meritorious." In fact, the Dyaks, like the Battas, have an undisputed reputation for sincerity, frankness, and honesty.†

It is especially religion that gives its sanction and consecrates these collective crimes, by preserving them in customs associated with its dogmas and rites. The Phœnician race, even when it had reached the highest degree of its civilization, still retained human sacrifices at Tyre, Sidon, and Carthage. The festivals of Moloch were real orgies of blood; the priests burned children in honor of the god, and the people, excited by the spectacle, were seized with such an agitation that many men were injured by the frenzied crowd. These horrors were repeated at Upsala by the Scandinavians, and at Rügen and Roncova by the ancient Slavs; yet the Scandinavians and the Slavs, although they were not so

* Letourneau, La Sociologie d'après l'Ethnographie, Paris.

† Bertillon, Les Races sauvages, Paris.

civilized as the Phœnicians, were people who had made considerable advance. Still, this is not so astonishing as to find human sacrifices in use even among the Greeks, with whom in the period of their grandeur the throng, at the mysteries of Bacchus Zagreus, cut up a goat, a sacrifice which was only a substitution; for anciently, according to Plutarch, it was a man that the throng cut to pieces on the altar of Dionysos Omostes—Dionysos, the flesh-eater. At the Thargelia, the Athenians gayly decorated a man and a woman who had been entertained at the expense of the state, escorted them in procession, and burned them at the entrance to the plain. The Celts bought slaves, whom they entertained liberally, and at the end of the year conducted in great pomp to the sacrifice. Every twelve months the Scythian tribe of the Albanians, according to Strabo, fattened a slave whom the people then massacred with lance cuts before the shrine of Artemis.

The great solemn popular festival of the Khonds included the annual immolation of a victim. After three days of indescribable orgies, in which women often participated dressed like men and armed like warriors, the victim was bound to a stake in the midst of the forest, and left there all night alone; in the morning the people returned, with a great noise of bells and gongs, singing and shouting; when the multitude had become well intoxicated with the uproar, and greatly excited by disorderly dances, the grand priest would command silence and recite a long prayer, and would then slay the victim, usually with a single stroke of the knife. The multitude, which had been waiting for that moment, rushed upon the quarry with piercing cries, each one trying to tear off a piece of the palpitating flesh, to hack the body to pieces.

A criminal ceremony exists among the tribes of the interior of Sumatra, which is without doubt the survival of an ancient and very cruel custom, that has passed in the course of time into a civil and religious duty. These people, although of rather gentle disposition, piously and ceremoniously kill and eat their aged parents, in the belief that they are performing a sacred duty. At the appointed day the old man who is destined to be eaten goes up into a tree, at the foot of which are gathered the relatives and friends of the family. They strike the trunk of the tree in cadence and sing a funeral hymn. Then the old man descends, his nearest relatives deliberately kill him, and the attendants eat him.

With some peoples animals take the place of human victims; but what we have said is sufficient to show that even with these peoples collective crime was formerly a solemn ceremony, although individual crime was already regarded as something to be condemned.

Till very recent times the people of Ispahan celebrated what they called the festival of the camel, or of the sacrifice of Abraham. The high priest of Mecca sent his adopted son, mounted on a blessed camel, which was led through the city with great pomp. At a given moment the king shot an arrow into its flanks; in a wink the poor animal was thrown down, hacked to pieces, carried off, and distributed widely. Every one wished for some of it, if it were only the smallest fragment, to be put into a kettle of rice. The Ghilicks and the Ainos adopted a bear, and fed it freely till the day of the public festival, when the people struggled for pieces of it.

Sometimes, in these criminal festivals, the public only plays the part of a spectator. It does not itself kill the victims, but only witnesses the slaughter, the bloodshed, which executioners are commissioned to perform. In Etruscan funerals the relatives of the deceased caused a convict to be publicly tormented; sometimes they blindfolded him and gave him a stick; then the executioners excited dogs against him, and the unfortunate victim had to defend himself with his stick. Such spectacles, which seem to have been amusing to the populace, are represented in many Etruscan paintings. The shows of gladiators at Rome, fights of gladiators with one another, and of gladiators with wild beasts, were simply transformations of the funeral sacrifices of the Etruscans, but more ferocious, for they generally ended in the death of a large number of men. The passive Roman people had such a passion for these games that they became a means of political domination; parties sought to secure the votes of the populace by giving them spectacles in which large numbers of men and beasts were killed.

In ancient Mexico, where crime was punished very severely, and was pursued with much energy, an immense throng came together every year to witness the numerous and terrible human sacrifices in honor of the god Huitzilopochtli. The spectacle, with its atrocious cruelties, was a source of delight to a people among whom intoxication, theft, and murder were punished with death, and who possessed a remarkable political organization and civilization. This transformation of the populace into spectators was, without doubt, an advance; but it is nevertheless surprising that such ceremonies should have been tolerated among peoples so civilized.

We see, therefore, that collective crime has opposed a greater resistance than individual crime to the progress of civilization. But why have these criminal festivals endured so long, while individual customs have been undergoing transformation? "The axiom, the whole is the sum of its parts, does not apply to multitudes," writes M. Reclus. M. Sighele has brought a large number of proofs to the demonstration of this precept—that is, that the

aggregate of many men presents some characteristics that are not found in the unities that compose it.* The psychology of a multitude of men is a special psychology; for the passions, the inclinations, and the thoughts of the individuals who compose it are combined in such a way that the conduct of a man mixed with a crowd will be quite different from that which he would observe if he were alone. The phenomenon we are studying is the effect of a similar difference between the characters of an aggregate of men and the characters of its units. A crowd of men is always more afraid of the new, more conservative, than are the men who compose it. For that reason a usage is more stable and less subject to variation in proportion to the number of men who observe it. The larger the multitude grows the more intense does its misoneism (hatred of novelty) become.

Every one can observe that it is easy for a man to change his individual habits, but that the habits of a family, being more fixed, are changed with greater difficulty. In fact, in some families there are ways that are preserved for two or three generations. But fixed as family customs are, they are unstable enough if we compare them to the usages of large aggregates, to the whole population of a city, for example. In all Europe, in Italy, France, and Germany some of the cities still celebrate the festivals of the middle ages, occasionally even Roman festivals, which plunge a whole population every year into the past again. The costumes, the banners, and the signals, everything in these festivals is old, and no one would be satisfied to use anything modern in them, for all their beauty would then seem to vanish. We find yet more superannuated usages when we consider still larger human aggregates; for while in the usages of a city we find survivals of its history, in the usages common to all civilized men we find survivals of the ancient primitive life, customs which appertain to the savage period. Of such, for example, is the worship of ancestors; for that exists no longer among peoples of high civilization, and rites relating to it have been nearly entirely abandoned. Yet these rites, which exist no longer in individual practice, still survive as a general usage among all Roman Catholic peoples, for the ceremony of the day of the dead is nothing else than a survival from the ancient ancestral religion. On that day all turn back in a mass to perform acts relating to that religion—visiting of the graves, renewing of the floral crowns, etc.—like those we find in use among savage tribes, although no thought or notion of the worship of ancestors is left among us. What does not exist as an individual practice still survives as a general usage.

* La Foule criminelle, Paris, 1892.

A mass of men is thus always more afraid of novelty than the men that compose it: these may change their feelings and their ideas, but they come together: the feelings and ideas acquired by the individuals will have no influence, or but little, upon their conduct. What is the cause of this contradiction? Why is a mass of men always more conservative than its components? Man, according to the law demonstrated by M. Lombroso, hates all novelty and tries to preserve everything that exists—his ideas and feelings—so long as he can, without changing them. Yet, when very strong necessities urge him, man succeeds in disturbing his inertia: he changes his habits and his ideas, and rebels against institutions and laws which he had once venerated; but it is always a painful task, a disagreeable effort for every man, even the best endowed, to carry this revolution into the system of his ideas and habits. Difficult as this change may be for each man, it is still more so when a collective usage is concerned; for then the opinion of all the other men to the same effect and imitation re-enforce the neophoby (or fear of novelty) natural to the man. The struggle is not only against one's own conservative instincts, but also against the fear of being alone in neglecting a usage which all others observe. "Everybody does it," is the answer most persons will give you when you ask them why they practice some quite absurd and ridiculous ceremonies. Further, no one has any particular interest in these collective usages, and therefore no one has special reasons for abandoning them; for these usages to pass away there must, therefore, be causes acting upon the whole mass of those who observe them, producing gradual decadence. Now these causes would naturally act more slowly than those which produce individual changes of manners, ideas, etc.; they will act more slowly, too, as the aggregate of men subject to their influence is greater.

So the genesis of criminal festivals is explained. When crimes become the object of legal repression and then of moral repulsion, men begin, each on his own account, to abstain from committing them; their views in relation to criminal actions gradually change, and those acts which formerly appeared honorable and glorious become gradually blamable. But these criminal festivals, to which the ancient liberty and the ancient glory of crime have given rise, being usages common to a whole tribe or people, enjoy the advantage of the greater stability we have remarked in collective usages. Each man removes himself slowly from crime but to return to it, as a member of the tribe, when the time for these civil or religious festivals of a criminal character returns. Thus, the Dahomeyan, who is no longer a cannibal, becomes an anthropophagist again in the great public festivals that are celebrated after a victory; the East Indians slay men upon the

foundations of a palace, but only when great public edifices are a-building; and the inhabitants of Sumatra, gentle enough in their ordinary customs, solemnly eat their old men, in the belief that they are thereby observing the most sacred of their duties as sons.

There is a still more curious side in this strange phenomenon. Everything old and superannuated—usages, customs, laws, etc.—is the object of an extreme veneration, especially among primitive peoples. The Tupis believed that if they should depart from the customs of their ancestors they would be destroyed; in some clans of the Malagasy innovation and evil are inseparable ideas; the Araucanians have many very ancient usages which they hold sacred and observe without any constraint; the Hottentot-Koramas are entirely free in their actions, except when ancient usages are involved. Since these criminal festivals survive long after crime has begun to be a morbid exception, they end by becoming sacred, profiting by the veneration attached to all ancient things; to abolish them or neglect them would be for these peoples a failure in the holiest duties. Consequently, the deed, which appears horrible and worthy of punishment when it is done by a single man, is regarded as honorable when it is performed by the whole tribe or the whole people in these festivals; the crime of the individual becomes the duty of the mass.

These sanguinary festivals have been able, by the effect of another cause, to endure long, even among superior peoples, like the Greeks and Romans. Unfortunately, crime, especially murder and crimes of blood, is not an action of which man has an innate horror; horror of crime, when it exists, is only the effect of a long training, of a painful education of civilization. Murder, M. Taine writes, introduces two extraordinary emotions into the moral and animal machine of man, which overturn it: on the one hand, the sense of all-power exercised without control, obstacle, or danger, on human life and on sensible flesh; and, on the other hand, the sense of bleeding death with its always novel accompaniment of contortions and shrieks. That is why all those who can dispose at their caprice, without any danger, of the existence of other men—kings, princes, and mobs—are usually inclined to cruelty. This tendency to the sanguinary pleasures of murder would be more lively among half-civilized peoples, who have been only a little while accustomed to respect for human life; and therefore criminal festivals, although contradictory to the state of individual manners, would be a choice amusement for them; for all the ferocious instincts which usually slumber in the man could give themselves free course in them. It explains to us, too, why men have tried to preserve these festivals by ameliorating them, when civilization would not tolerate their primitive feroci-

ty; when human sacrifices became impossible, animals were substituted; when combats between men seemed too horrible, fights of animals—of cocks, bulls, and fishes—were instituted. It has been said that the minister who should try to abolish bull fights in Spain would provoke a general revolt. In these cases the multitude are only spectators of the carnage; but when a people like the Spanish loves these sanguine representations with so furious a passion, can we be surprised that people less civilized ardently lust after the pleasures of collective criminality, although their manners may be in course of amelioration?

Besides having a historical interest, the study of these criminal festivals is very important for criminology, because it brings numerous evidences in support of the atavistic theory of crime. In discussing the questions whether crime is a phenomenon of atavism, or whether at least atavism does not play a considerable part in criminality, many criminologists have maintained that while most savage peoples are thieves, cruel and dissolute, nothing authorizes the affirmation that the ancestors of civilized peoples resembled them. We have, indeed, no direct proof of this fact; but if, in default of proof, we examine the usages and institutions of these peoples, which are a kind of fossil remains of their evolution, we may conclude that the primitive ancestor of the Greek was no more moral than the Australian or the Javanese. These criminal festivals can be explained only by assuming an ancient condition of moral disorder; which admitted, everything becomes clear, and is susceptible of a simple and logical explanation.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

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The prevalence of lake basins in glaciated countries is accounted for by Mr. J. C. Hawkshaw by assuming that whenever earth movements take place in limited areas they will tend to form basins. Since such movements are as a rule gradual, the basins will tend to fill up with water-borne detritus, the growth of vegetation, etc., as fast as they are formed. In glaciated countries, however, they are occupied with ice, and that protects them from being filled up by such processes, and they will be preserved to appear as lake basins when the ice melts. Such basins are probably more numerous in rainless countries than we are aware of, for, not containing water and not presenting a different appearance from the rest of the country, they do not attract attention. An instance of them is presented in the Raian basin of Egypt, which has been surveyed by Mr. Cope Whitehouse, with a view to making use of it in works of irrigation.

A series of Roman tools, more than sixty in number, discovered in a rubbish pit during excavations at Silchester, England, in 1890, are described by Sir J. Evans. Among them are anvils, hammers, chisels, gouges, adzes, axes, and a carpenter's plane. The find also included two plow-coulters, a sword-blade, a large gridiron, a lamp, and a bronze steelyard.

# THE URAL COSSACKS AND THEIR FISHERIES.

By Dr. N. BORODINE.

FISH COMMISSIONER OF URAL DISTRICT, RUSSIA.

THE Ural Cossacks, who live on the boundary between European Russia and Asia, along the middle and lower part of the Ural River, have been known in Russia for a long time, not only as brave soldiers in war time, but also as peaceful fishermen, carrying on the fishing industry on a very large scale and in quite a peculiar manner.

More than three hundred years ago the first band of the so-called "free people"—Cossacks—appeared on the *Yaik* River, the original name of the *Ural* River.*

Who were this people? They were pioneers of liberty, people tired of cruel serfdom and discontented with subordinate life in Russian czardom, who tried to organize their life on a basis of absolute freedom and after their own ideas in the vast steppes of southeastern Russia.

The free colony grew rapidly, thanks to large additions of discontented people from all neighboring provinces of Russia and from foreign countries. A careful examination of an early census of the Ural Cossacks made by order of Peter the Great (1723) shows us that among the immigrants were Poles, Hungarians, numbers of peasants from different parts of Russia, many dissenters from the Russian Orthodox Church, prosecuted by government, a great number of Don Cossacks, etc. Differing in nationality as well as in language, one thing was common to all, the ardent longing for freedom and independent life. Is it not a counterpart of the earliest period of immigration to this country, when those who were persecuted in Europe sought freedom elsewhere? An old Cossack, when asked once about the origin of the Ural Cossacks by a well-known folklorist, answered, "The bee gathers from every flower its best, and what is the result?"

"Honey," replied the astonished man.

"Well," said the Cossack, "in such a manner grew our community: from everywhere came the best and brightest men and organized our society."

Do not you think that this simple and witty simile well illustrates the history of early colonization in this country as well as the origin of the small community of which I speak?

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* The names of *Yaik* River and *Yaik* Cossacks were changed to *Ural* River and *Ural* Cossacks by imperial order in 1775 after Pugacheff's rebellion, in which the Yaik Cossacks took a very active part, the order stating that the old name should be abolished and entirely forgotten.

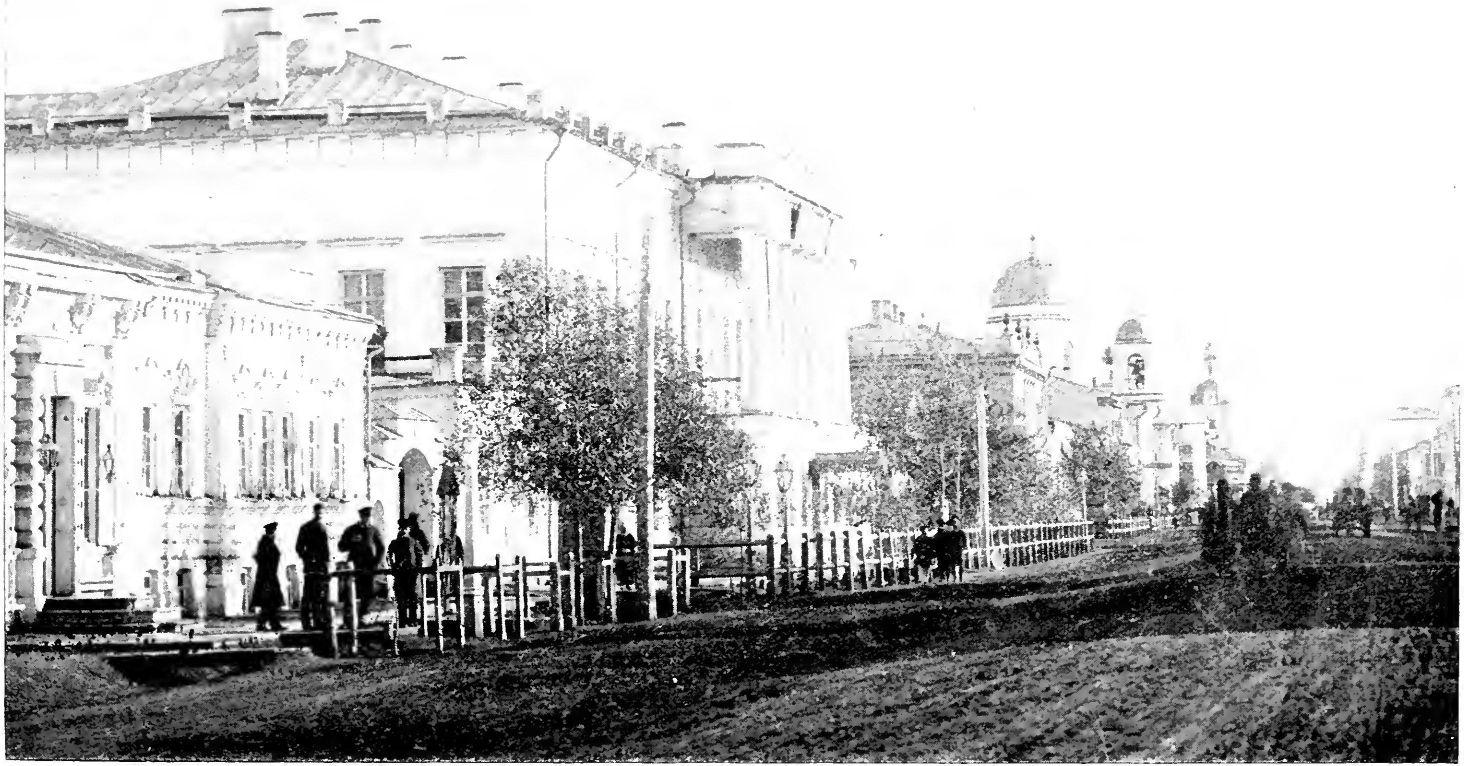

Fig. 1.—A Street in Uralsk.

In 1580, we read in a historical document, came to the lower part of Yaik River a band of Cossacks and expelled from the country the remainder of a once famous and strong Gold-Horda of Tartars. They ruined Saraitchik, the chief residence of the Tartars, and sailing up the river, founded a fortress near the place where is now situated Uralsk, the chief city of the Ural Cossacks.

At first these warlike bands lived by a rather peculiar industry —marauding of hostile neighbors (Tartars) and sometimes commercial ships on the Caspian Sea *en route* from Khiva and Persia.

> "Ah, formerly we Cossack fellows
> Sailed pretty well on thy waves,
> In light boats looking for prey,
> For the prey from Khiva and Persia,"

says one Cossack song about this old time.

It is difficult to say when the Ural Cossacks changed this industry for the more peaceful one of fishing. Probably this was

Married woman. Old woman. Girl.

Fig. 2.—Types of Ural Cossack Women.

very soon after the conclusion with the Muscovite Czar of a kind of protectorate (1613), which is commemorated by a peculiar old custom of presenting fish and caviar from the community to the imperial court. This custom, sanctified by more than three centuries, exists yet, and was doubtless a token of loyalty and hospitality similar to the custom of the Russian agricultural population of presenting bread and salt on like occasions. As the Russian peasant poetizes his hard agricultural labor and surrounds it with

an aureole, so the Ural Cossacks poetize their fisheries and everything in connection with them. In almost every popular song of this country is mentioned, under all kinds of poetical names, the Ural River with "its golden bottom" and its "silver banks," and one of the most favorite local songs is an ode or hymn in honor of the Yaik River (the historical name remains in poetry), the foster father of the population. The economical importance

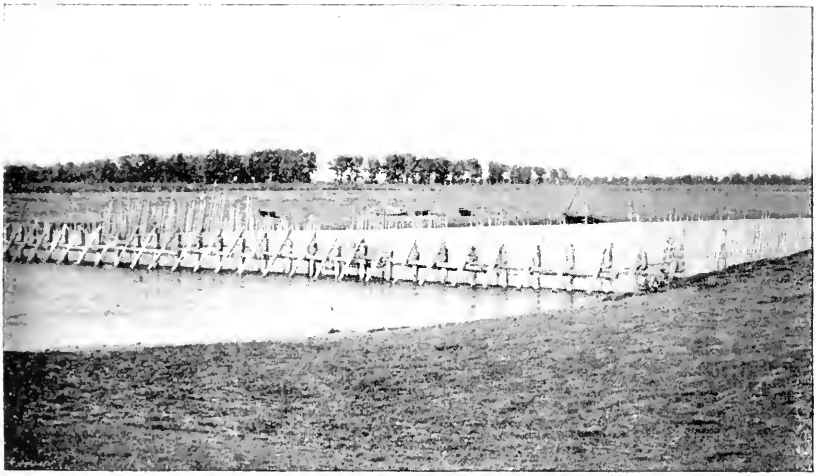

Fig. 3.—Railing across the Ural River.

of the fisheries for this people is so immense that it influences their whole life, not excepting the military service. The right of fishing in communal waters does not belong to any but members of the community, who, on the other hand, are compelled to undertake military service. The Ural Cossacks have ready for the service every year about three thousand cavalry, and in case of war every adult may be called on to serve as a soldier. The entire population is about one hundred and ten thousand souls.

Thus, when one part of the men is engaged in military service, the other part, which remains at home, is forced to procure money to pay the expenses of equipment for the outgoing soldiers, and also to make their own living.

Only by bearing this heavy double burden have the Ural Cossacks succeeded in acquiring exclusive rights to the land and river colonized by them, and to preserve until the present time some independence in their home affairs with a peculiar economic organization of the community as an entire body. Much struggling and fighting was done in the early existence of this small community in order to gain this measure of independence from the Muscovite Government, which has always had a strong tendency to centralize different parts of Russian territory under

one absolute power. From its early existence until 1723 the community was entirely independent in its interior home affairs. It was a purely democratic republic, with an elected chief, or *ataman*, representing the executive power. All governmental affairs were transacted in a communal "circle" or general meeting of the members of the entire community. In 1723 the Russian Government first laid its hand on the independence of the community, and since that time the election of the chief must be approved by the Government in order that the appointment may be legal. In 1775 the communal "circle" was abolished and the community entirely lost the right of electing its *ataman*, who since that time has been appointed by imperial order. The only thing still remaining is the economic organization, where the independence is very characteristic.

To return to the fisheries and their importance in the life of the Ural Cossacks. I should mention that the Ural River is the

Fig. 4.—Fall Fishing on the Ural River. Carting Boudaras.

only large river that is entirely given over to the fishing industry, all sorts of commercial navigation being absolutely forbidden from Uralsk to the Caspian Sea (three hundred and thirty miles); and more than that, in some places of the river, where sturgeons collect for their winter sojourn, no one is permitted to run a boat, to make any noise, build a fire on the shore, etc. By the laws of the community summer fishing is almost entirely prohibited, for the purpose of protecting the spawning, also for the reason that fish caught in summer will not bring a good price.

They let fish enter the river from the sea and settle there quietly for the winter sojourn. All possible means are used to secure for the fish an unrestricted passage to the upper parts of the river, but not beyond Uralsk, where a railing is constructed across the river to prevent the larger fish going farther up. Owing to this arrangement the lower part of the river from this railing to the mouth forms a large natural fish pond (three hundred and thirty miles in length) where the fish are carefully watched by a great many fishwardens until the regular time for

Fig. 5.—Fall Fishing on the Ural River. Waiting for a Cannon-shot Signal.

fishing, which is fixed by general consent of the community. It is easy to understand what a thorough organization is necessary to conduct successfully this complicated plan for the distance of three hundred and thirty miles, and which has to deal with more than ten thousand fishermen. It is indeed a complete organization. The central administration, residing in Uralsk, controls all this business, assisted by numbers of local agents through the whole country. A steam cruiser, steam launch, and a number of sailboats constantly watch the mouth of the river and the neighboring banks and protect them from poachers. It should be mentioned that the river, with its fishing grounds and part of the Caspian Sea, belong to this entire community, consisting of a hundred and ten thousand people. There is no private property belonging to individuals or villages adjacent to the river, and an elaborate and detailed general plan must exist to regulate all this immense business in such a manner that the interest and rights of every member of the community shall be properly protected.

Fig. 6.—Fall Fishing on the Ural River. Seining on the Fishing Grounds.

The community does not believe that these interests may be protected by free competition, as is the case elsewhere.

As a rule, one part of the river (the lower) is intended to be fished out in the fall, the other (upper) portion in winter. The fall fishing begins about the 17th of September. On a certain day the "fishing army," as it is called, moves to the fishing places, which are sometimes very far from home. The Cossack carts contain not only nets and provisions, but also the boat used in this fishing. These boats, known by the name of *boudara*, are so light that two of them may be carried on one cart.

When the "fishing army" comes to the proper place, the boudaras are taken from the carts, and early in the morning appointed for commencing fishing they are placed at the edge of the water, right along the river for a distance hardly compassed by the eye. No less than three thousand boats, each containing two men, meet here. To maintain discipline, a chief, or "fishing ataman," is appointed, and several representatives of the fishermen are elected to assist the chief. The ataman gives a signal to commence fishing by a cannon shot, and then the crowd rush to the boats, and in less time than you can realize what has happened all the fishermen are in their boats and a peculiar kind of boat racing commences. They put forth their utmost strength and ability to outrun each other, and to be first at the place where the fish have gathered in shoals, these places being known by the reports from the fishwardens. Once here, they throw out their small seines and haul them from two boats. Various kinds of sturgeon (from thirty to six hundred pounds weight), sander, carp, bream, and silurus are the principal fish caught at this fishing. The seines differ, of course, in the size of their meshes, according to the fish for which they are intended; but no one has the right to use any but the regular size, large seines being admitted only behind the "fishing army." Hence, as in a noble fight, the chances of all combatants are as nearly equalized as possible by the regulations above mentioned, fixed place and time, regulated tools, etc. Success depends only on the ability and strength of the fishermen.

The total catch during the fall seining is from fifty-four million to seventy-two million pounds, which includes two hundred and sixteen thousand pounds sturgeon and about twenty-one thousand six hundred pounds caviar.

When fishing, the fishing army always goes down the river, covering from twelve to twenty-four miles a day, and in this way moves after a time to the mouth of the river, which is reached, as a rule, at the end of October. At this time the ice begins to accumulate in the river and closes the fishing season.

Another army of equal magnitude, consisting of fish dealers with a large number of carts, accompanies the fishing army.

These carts are contracted to carry the catch to the city markets (there is no railroad in this steppe). No less than ten thousand carts are used here, and if you add ten thousand more carts belonging to fishermen, you may imagine how imposing must be the sight of the peaceful armies.

The fishing in the upper part of the Ural River, as I mentioned before, is carried on in winter, under the ice, and that is the most peculiar of all fisheries. It is called *bagrenie*, which means "hooking," because the fishing is accomplished by a peculiar kind of hook. When the ice in the river becomes firm enough to support the weight of the fishing army, which generally takes place in December, an order is given by the communal administration for the army to meet at Uralsk, from which point the fishing is begun. On a fixed day, thousands of people, old and young, hasten to the appointed place.


FIG. 7.—URAL FISHERMAN READY FOR THROUGH-ICE FISHING, CALLED BAGRENIE.

Let us now see how the fishermen dress for this winter fishing. One of them ready for work is represented in the picture. Light and comfortable garments, waterproof mittens and boots; in one hand a chisel, in the other two haft-hooks—the long one (with a haft of seven or more fathoms) is used for catching fish, lying (as a rule) in deep places on the bottom; the short one is destined to hold the fish when it is brought to the surface of the ice.

At about 9 A. M. the banks of the river, near the place where the shoals of fish have gathered, are crowded with thousands of horses and sledges, so that it becomes difficult to reach the river. Fishermen go down to the ice and stand on it in endless lines on both banks of the river, anxiously waiting for the signal—a cannon shot.

The ataman has gone out in midstream; every one is looking for him impatiently. The signal having been given, two living waves of people rush forward to the middle of the river, and the

Fig. 8.—Winter Fishing on the Ural River, called Bagrenie.

arduous work begins, every one trying to be the first to make a hole in the ice with a chisel. In a few minutes an entire forest of long hafts grows up over the river, as though some magic power had been at work. The fisherman moves the haft up and down, and listens intently that he may know when the fish touch the hook. Once this has happened, he hooks the fish by an alert movement, then hauls it immediately up to the surface of the ice, calling in the mean time for help from his fellow fishermen. They fish here, usually, in groups of from six to twenty men, for it is not easy work to pull up a huge sturgeon of several hun-

Fig. 9.—Fall Fishing on the Ural River. Dressing Fish by Natives.

dred pounds weight. In a very short time the surface becomes marked with blood and covered with big fish.

The most important fish caught in winter are different kinds of sturgeon, viz., the large sturgeon (*Acipenser huso*), Russian sturgeon (*A. Guldenstädtii*), star sturgeon (*A. stellatus*) and *A. Shypa*. Each decidedly differs from the other and from species caught in America. For the flesh and particularly the roe (caviare) very high prices are obtained in the winter season; one single big female of the "large sturgeon" is sold for 100 to 200 rubles ($64.50 to $129).

Of course, not every one succeeds in catching such a valuable fish; on the contrary, many, in spite of great efforts, do not catch any, not even the smallest sturgeon. Nevertheless, this fishing being an alluring lottery with winnings, everybody hopes to be a lucky one, and this is the reason why so many of the Ural

Cossacks attend this favorite winter fishing. Not less than ten thousand people participate in it; about a million and eighty thousand pounds of sturgeon and the same amount of other fish (sander and silurus) are caught and fifty-four thousand pounds of caviare prepared. The average price for sturgeon is 13·8 cents a pound, and for caviare about a dollar and a half a pound.

In addition to the fisheries described above, the Ural Cossacks carry on important fishing in the Caspian Sea in spring and also in winter; the methods not being of an unusual character, I omit a description.

The total amount of the local fishery business can be expressed in the following figures for 1891: 5,817,464 pounds of

Fig. 10.—Fall Fishing on the Ural River. Making Caviare.

sturgeon, 73,960,824 pounds of other fish, 1,076,076 pounds fish roe, 173,348 pounds dried sturgeon steak (*balik*), and 6,084 pounds isinglass were exported from the territory of the Ural Cossacks. The total amount of fish landed must have been larger than these figures, owing to the local consumption, though in comparison with that exported it is quite insignificant. Thanks to the duty for every pound of fish exported from the Ural Cossacks' land, local fish trade statistics are excellent, and we are in possession of very valuable figures, similar to the above, for more than half a century, which gives an exact idea of the direction, increase, and decrease of this important industry in a very large and definite region.*

* The diagram is to be seen in the Russian Department of the Fishery Building at the World's Fair.

The revenue from the exported fish is used for different public expenses, and among others for the improvement of local industries in general and the fisheries in particular. Thus, during the last three or four years, a very fine agricultural school, with a model farm, has been erected at a cost of more than one hundred thousand dollars. They have several scholarships in the leading universities of the empire, and maintain a very large high school. For the purpose of making improvements in local fisheries a person of suitable education and familiar with home fishery affairs is sent to foreign countries to study the different branches of fishing industry, including pisciculture. I have the honor of being charged with this task. Two years are spent in these studies in all places of fishing importance in the different countries of Europe and North America, and now I have completed them by getting information at the World's Fair.

The Ural Cossacks' community is represented, although not largely, at the World's Fair, in the Russian department in the Fishery Building, and I should be much pleased if the foregoing could call the attention of visitors to the peculiar fisheries of my fellow Cossacks.

At the same time I would like to give some idea of the home life of this strange race, who are known in foreign countries only as a semi-barbarous, warlike people on horseback with formidable lances, etc. The foregoing, I hope, will add something new to their characteristics.

## THE PROGRESS OF PSYCHOLOGY.

By Prof. JAMES McKEEN CATTELL.
COLUMBIA COLLEGE.

FOUR hundred years ago it was possible for Columbus to discover a new world. The circle of the earth is long since complete, but in the presence of each man is an unexplored world —his own mind. There is no mental geography describing the contents of the mind, still less is there a mental mechanics demonstrating necessary relations of thought. Yet the mind is the beginning and the end of science. Physical science is possible because the mind observes and arranges, and physical science has worth because it satisfies mental needs. The mind being thus the center from which we start and to which we return, there is reason for wonder that we know so little concerning it. Each of the physical and biological sciences includes a large mass of facts admitted by all students, and many theories which by general consent are accepted as working hypotheses. In psychology, on the other hand, there seems to be no common

ground continually increasing. The text-books contain speculations which are unverifiable, and often have little to do with psychology. They include descriptions of things which no one could understand from the description, but which every one understands without it. There are often anecdotes, which belong to the nursery. Then, in more recent times, we find accounts of the eye and brain, which are sometimes good physiology, but which seldom increase our knowledge of sensation and thought. It may be added that in the popular mind psychology consists largely of ghosts and mesmeric exhibitions.

But in the midst of confusion there are signs of order. Psychologies are now written which do not range at large through metaphysics, logic, ethics, and æsthetics, or, if they do, the writers at least know where they are wandering. Description and analysis become of greater value as introspection is more careful and words are more exactly defined. When works on physics, physiology, and pathology are sifted, there is found to be a considerable remnant which belongs to psychology. Even "telepathy" and hypnotism contribute their modest quota of facts. Comparative zoölogy, anthropology, philology, history, and art discover interrelations with psychology. Lastly, the attempt has recently been made to apply the methods of natural science, and even the measurements of exact science, in the study of the mind.

The backwardness of psychology is not indeed surprising. Certain material needs must be satisfied before there is time for self-observation. Even the lower animals are concerned with the changes of day and night and the return of summer and winter, with the growth of plants on which they feed and the habits of beasts which prey upon them. Astronomy, physical geography, botany, and zoölogy have their first foundation in remote, prehuman times. When the savage appears, he needs must attend to the external world, whereas self-observation would profit him but little. If his life depend on killing a bird with a stone, he must know the habits of the bird, and even something of the course of projectiles. Should he stop to consider the relation between sensation and movement, he would not survive to tell his thought. Even nowadays, when every one must have exact knowledge of some part, however small, of the material world, there are but few who have time to study their mental life, which indeed goes on none the better for being watched.

The elements of physical science are not only more necessary to life than knowledge of the mind—they are also more easily obtained. The facts of the material world are comparatively constant and accessible to observation. The stars return daily in their courses, and the plants repeat yearly their monotonous

lives. Inert matter may be observed and measured more readily than the living body; physics consequently preceded biology in its development. The changes of mental life are more fleeting and obscure than those of the body. It is natural, therefore, that, as biology is more backward than physics, so psychology should be more backward than biology. There was a time when all the sciences were nourished by philosophy. In Greece the philosopher and the man of science were identical, and those who most advanced mathematics and science in the revival of learning are called philosophers. With the increase of knowledge division of labor became necessary, and the separate sciences were defined. Those sciences were first developed which found data ready in the common knowledge of daily life, and which embraced subjects where experiment and measurement could be most readily used. The close relation in which psychology still stands to philosophy is thus explained by its comparative backwardness. This relation is not essentially different from that of the other sciences. Philosophy is not the arithmetical sum of the special sciences, but has a peculiar task. It seeks to investigate the conditions of knowledge, and to form a theory of the ultimate nature and meaning of things. Psychology is no more concerned with these matters than is physics. Experimental and mathematical physics need not and should not investigate the origin and ultimate nature of matter, nor should psychology as a natural science concern itself with the origin, destiny, and meaning of mind.

The subject-matter of psychology corresponds exactly to that of any other natural science. As physiology studies the phenomena of the living body, so psychology studies the phenomena of mind. It is often urged as an objection to psychology that the student can observe one mind only, but it is equally true that the student of physics can observe *with* one mind only. Were mental processes so irregular and idiosyncratic as is sometimes assumed, there would be no science of psychology, but physics would be equally out of the question. Psychology is not concerned with individual peculiarities, but with the laws to which all mental processes are subject. Its position is similar to that of physiology, which studies individual organisms in order to learn general truths concerning nutrition, movement, etc. The problems of psychology are evidently complicated by the fact that individual minds differ. But this difference is largely a matter of comparatively unimportant detail. The position of psychology is not very different from that of other sciences. Should astronomy seek to determine the orbits of all the satellites, of all the planets, of all the suns in the universe, it would have a hopeless task; but, if we understand one solar system, we have an astronomy to a large extent universal.

The methods of psychology are the same as those of other sciences. Science has its beginnings in common knowledge of daily life collected for practical ends. This knowledge is systematized, often in an artificial manner, and facts, often fancies, more remote from daily experience and usefulness are added. Attempts are made to simplify and explain, usually by arbitrary hypotheses. Thus it was thought by the early Greek physicists that the earth is explained by saying that it all consists of water or air or fire. Even in recent times it was thought an explanation to say that water rises in the pump because Nature abhors a vacuum, or that life is explained by the presence of a vital fluid. But as science advances it depends more and more on experiment and measurement. Data are seldom admitted which can not be verified by any competent observer, and mere matters of fact take a subordinate place. Exact science consists almost exclusively of measurements and the relations of quantities.

Psychology until very recently was in the position of science before experiment and measurement had been used. It consisted largely of useless descriptions, artificial classifications, and verbal explanations. A preference was given to matters which are extraordinary and unverifiable. But in the progress of science it has at last become possible to apply experiment and measurement to the mind. We have to-day laboratories of psychology where facts may be discovered, measurements made, and the results verified by every trained student.

To prevent misunderstanding, it may be worth while to notice what is not done in laboratories of psychology. They are not intended for the study of physiology. The functions of the nervous system may throw light on the workings of the mind, but the debt is reciprocal. We know, indeed, more concerning attention, memory, and thought than concerning the cerebral processes which may precede or accompany them. The commonly used term physiological psychology is awkward. There is a science of physiology and a science of psychology, and there are relations between body and mind. But these relations are wider than this—they are between matter and mind. Thus we know that vibrations of a special sort may be accompanied by a sensation which we call blue, but we know almost nothing concerning the corresponding processes in the eye and brain. The world is one world, and all science is interdependent, but the development of psychology has drawn a sharper line between mental and physical processes than was ever recognized before. The distinctions of material science are comparatively artificial, resting on our ignorance rather than on our knowledge. Whether bodies be as large as planets or as small as atoms is not a matter of great consequence. If we but knew the laws of matter in motion, they would

obtain equally in astronomy and chemistry. The phenomena of the living body must in the end be subject to the principles of physics, and physics must in the end become mechanics. But sensation, attention, and feeling can never be reduced to matter in motion. A complete correlation between mental and physical changes may be established, but the most perfect knowledge of the processes of the brain would of itself throw no light on the nature of thought. The blind man will not learn to see by studying the changes taking place in the combustion of a candle. Psychology can never be made a branch of physiology.

Laboratories of psychology are for the study of mental processes. It would not be possible in a single article to give an account of what has been accomplished by experimental psychology, nor would tables, curves, and mathematical formulæ prove interesting reading. "The plain man," in Bishop Berkeley's phrase, "undebauched by learning," is apt to ask, What is the good of all this? It may, therefore, be better to give several examples of the practical application of the results of experimental psychology. Pure science is not, indeed, an art whose end is to produce changes in the course of Nature. Astronomy is commonly regarded as the noblest of the sciences, but we can not alter the orbits of the planets, and the higher astronomy is not useful in the affairs of daily life. Science is an end in itself, as are the fine arts. It is good because it satisfies mental needs, and makes life better worth the while. But material science, while searching for truth, has not failed to contribute to the practical needs of society. Its applications in the arts and manufactures have guided the course of civilization. One man to-day can do the work which required ten men a hundred years ago, and the poor have now comforts and opportunities which were formerly not within the reach of the rich. In like manner we shall probably find that more exact knowledge of the mind will have many applications in pedagogy, in political science, in medicine, in the fine arts, and, indeed, in the whole conduct of life.

Let us consider pedagogy. Our methods of education have been greatly altered in the past few years, and more changes will follow. But we go forward blindly, not seeing the way, often retracing our steps. The poor children contribute to the progress of educational methods somewhat as the frog contributes to the progress of physiology. But we may hope to replace vague surmises with exact knowledge. In our laboratories of psychology we can test the senses and faculties of children. We can determine whether the course of study is developing or stunting fundamental characteristics, such as accuracy of perception, quickness of thought, memory, reasoning, etc. We can learn what methods best strengthen each of these faculties without injuring the others.

The overtasked teacher finds a child slow, and places it with more backward children, which increases its slowness. A more exact test of the child's mind may show that it is indeed slow, but that the slowness is more than counterbalanced by intensity and range. Methods must be applied which will shorten the time of thought, and will not interfere with its force and extent. We can determine what size and composition of class, what length of lesson, session, and term are most favorable. We can learn whether it is better for the student to do a thing, to see it, to hear it, or to read about it. We can never build a road to learning which need not be traveled by the student, but we can build a royal road in the sense that it is the shortest and best of roads. Above all, our tests and measurements will demonstrate the value of learning itself, and tell us whether under given circumstances it is secured by the development or sacrifice of more essential qualities, such as health of body, serenity of mind, common sense, honesty, and kindliness.

In laboratories of psychology not only children but every one can be tested, and small defects or changes in the senses and faculties can be discovered. Psychology may thus become an ally of medicine. Degenerations which escape common observation, and even the practiced eye of the physician, can be detected and measured by scientific methods. The overstrained clergyman or man of business can be told when a holiday is necessary, how long it must last, whether rest or amusement be required. As an example of the co-operation of psychology and medicine, surgery of the brain can be given. The part of the brain which is diseased is determined by psychophysical methods, the skull is opened, the diseased part of the brain is removed, and the patient may be cured. Psychological methods are useful not only in the diagnosis but also in the cure of many diseases. We know much better than formerly how the insane, the vicious, and the criminal should be treated. We know, for example, that social work is far better than solitary confinement. Even diseases not directly dependent on the nervous system may be cured by psychophysical methods—for example, suggesting to the patient in the hypnotic state that he will be cured.

Those in good health may also profit from an examination in a laboratory of psychology. Valuable traits can be determined as well as defects, and the profession and mode of life most suitable to the person can be indicated. As has been suggested by Mr. Galton, such tests would be peculiarly useful in civil-service examinations. They would determine the real qualities and fitness of the candidate in addition to (or in place of) the superficial knowledge temporarily acquired by "cram." While we have but little power to alter the individual character, we could exert

great influence on the future of the race. If we determine what traits are valuable, and how these can be developed by suitable marriage, and made universal by early marriage, we may hope for practical results of immense importance. By the development of a code of honor, or by direct encouragement of the parents or the State, degenerative tendencies could be eliminated, and valuable traits could be developed much more rapidly than occurs in the slow course of natural selection. Mr. Galton has shown that the offspring of early marriages will soon supplant the offspring of later marriages. But as things go at present the thoughtless and criminal are apt to have offspring early, while the reliant and mentally endowed postpone marriage until a long course of education is accomplished and a social position is secured.

It is not necessary to dwell on other applications of psychology. Its relation to the fine arts is evident. The external form of art is directly fitted to the senses and its inner essence to the mind. In political economy we need to know more concerning the interest, passions, and needs of the people. Ultimately, we shall be able to determine what distribution of labor, wealth, and power is the best. Indeed, the measurements and statistics of psychology, which at first sight may seem remote from common interests, may in the end become the most important factor in the progress of society. The whole course of life will move forward in straighter and broader channels when we no longer depend on instincts developed by the beast and savage, but on knowledge and reason guiding to an end.

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Dr. Baumann, in his recent journey in countries north of Lake Tanganyika, discovered the source of the Kagera or Ruvuvu River in about latitude 3° south, in a lofty range of mountains known as the Mountains of the Moon. The Warundi—whose ancient kings bore the title of Mwezi (Moon), and who looked upon Dr. Baumann as one of their descendants just returned from the moon, and consequently received him with noisy demonstrations expressive of their joy—look upon this spot as sacred. Within a wood close by they used to celebrate the funeral rites of their kings, whom they buried on the top of a mountain rising above the Mountains of the Moon.

Dr. D. G. Brinton has made a study of the Song of the Arval Brethren, a priestly sodality of ancient Rome, of presumed Etruscan origin, which was sung at their annual festival, and has found in it the name of a divinity which is also a divine name among the Libyan tribes of northern Africa, and is perhaps the root of the name of those (the Berber) tribes. This hint of connection between the Etruscans and these peoples is supported by the discovery of the name of "a man of the Tursha" at Gurob, near the Libyan boundary of Egypt, and of an Etruscan ritual book in the same region. The stem Adur, equivalent with that of Tur in Tursha, and with Etrur in Etruria, occurs also in the name Adurmachides—the fighting Adurs—given by Herodotus to a tribe living in the same region."

# A CHARACTERISTIC SOUTHWESTERN PLANT GROUP.

By HENRY L. CLARKE.

A CURIOUS fascination gathers round any type of plant life that stands alone, as peculiarly characteristic of some one region of the world; and still greater does the interest become when we find, instead of a single type, an extensive group of closely related types holding a thus isolated position, and constituting a flora of themselves apart from surrounding plant realms. But such instances are rare—their very fewness primarily accounts for the impression they make upon both scientist and general

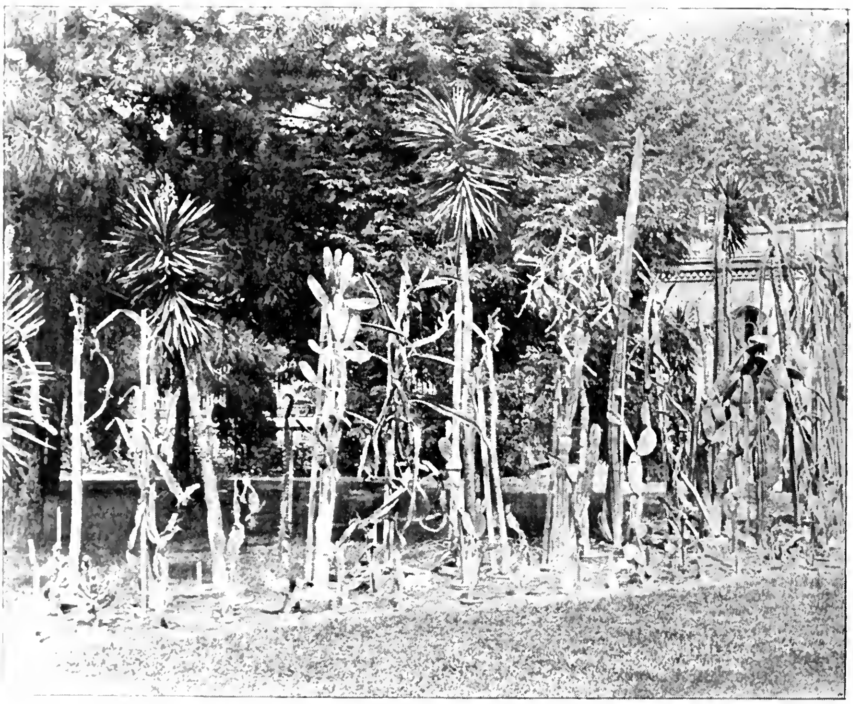

Fig. 1.—Opuntia, Cereus, and Yuccas.

observer. In one corner or another of every continent botanists have found oddly specialized floras, distinct in aspect and purpose from the general run of vegetable forms. Many of these cases are of insignificant importance, save in their immediate interest to the specialist; some attract greater attention, as filling an especially noticeable gap in the series of plant relationships; a few become of widespread interest not only through unique specialization of structure, but also by virtue of their holding a really

extensive and vitally important place in the economy of Nature. Of these last few one instance rises up most prominently of all, certainly without a full parallel elsewhere in the field of botanical science—and do we realize that it stands almost at our doors? It is the great three-typed plant group that forms the major part of

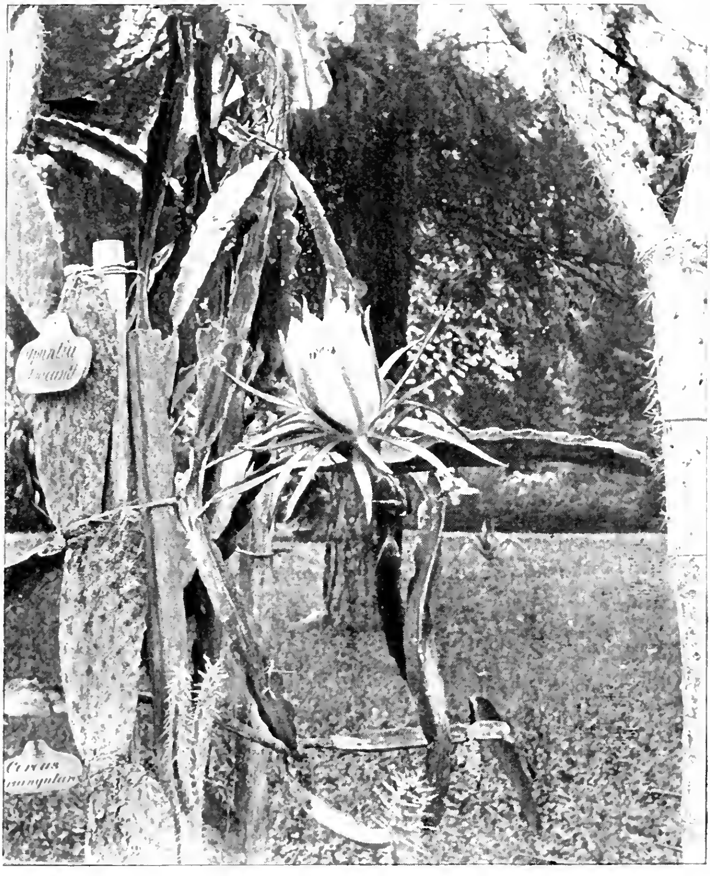

Fig. 2.—Cereus triangularis.

the flora of the far Southwest, on the arid plateaus and plains and rocky mountain heights of Arizona and New Mexico, western Texas and southernmost California, and over the boundary line far into northern Mexico. Here is the fatherland and here the supreme province of those three marvels of plant life—the cacti, with their strangely specialized vegetative body; the agaves, to which popular tradition has attached an epithet of fitting dignity in the name of "century plants"; and, thirdly, the yuccas, which claim, in addition to their floral splendor, the distinction of manifesting the interdependence of the flower and insect worlds with

probably more striking force than obtains in any other single instance throughout the range of flowering plants.

Only within the memory of men still in the prime of life has the full significance of this Southwestern flora dawned upon the world of science. Far back in the history of early explorations travelers and naturalists had recognized the odd character of these north-Mexican plant forms, but to realize their inward meaning required the elaborate monographing of Engelmann and the broad generalizing of Asa Gray. For, strange as it may seem, one investigator after another, enthusiastic over the rich flora spread in such profusion from our Atlantic seaboard westward beyond the Rockies, nevertheless shunned, because of the many difficulties presented, this threefold group of Southwestern vegetation. Yet this, above all else, was a flora peculiarly American—originating, so far as we have yet been able to discover, on American soil, and belonging to America alone. So here there was a prospect of opening up to science a new aspect of plant life, and in due season the men came with the opportunities and inclination to accomplish the task. Foremost of all, and more than all the rest, stood forth the St. Louis physician, Dr. George Engelmann, a skilled man of medicine, with botanical inspiration. In him there seemed to be an especially keen appreciation of the opportunity offered for vastly aiding the cause of botanical science by the systematic study of little-known groups of plants; and through labors of this nature, in addition to his note as a physician, he placed his name among the greatest of monographers in the annals of botany. And to him belongs the credit of turning the full light of science upon the cacti, the agaves, and the yuccas, while through his investigations of these types the attention of our great American systematist, Asa Gray, was first directly turned to the vegetation of the Southwestern highlands. One of the absorbing problems of Gray's life-work was what he once fitly termed "botanical archæology"—the study of the geographical sources of our wealth of flora, and of the paths by which it had passed from one region to another. Years of experience had enabled him to propound the masterly theory of the great wave of ancient plant life sweeping down from the north and giving to the Old World and the New floras that have so many types in common. But later, largely in the light of Engelmann's revelations, Gray was brought to fully realize that a second great source of the peculiar elements in our flora lay in the Southwest, down on to the Mexican plateau, and beyond the reach of the influence of the Glacial age. Here was the possible source of a vegetation strictly American, and to it might be traced many now widely scattered tribes, but particularly and most obviously the three unique types we are especially considering. These have come down to us, in the land of the

Aztec, as the descendants of an American flora whose traces are lost in far-off geologic ages, even as the forefathers of the Aztec are shrouded in the mist of prehistoric centuries. In truth, there seems a striking fitness in associating these odd monarchs of the soil with the barbaric majesty of the empire of Montezuma: a John Ruskin might say, the cactus typified the Aztec's sturdy, unwithering energy and stoic cruelty; the agave, his lofty nobleness of mind; and the yucca, the passionate beauty of his nature. But let the sentiment stand—the Aztec has passed away, and yet

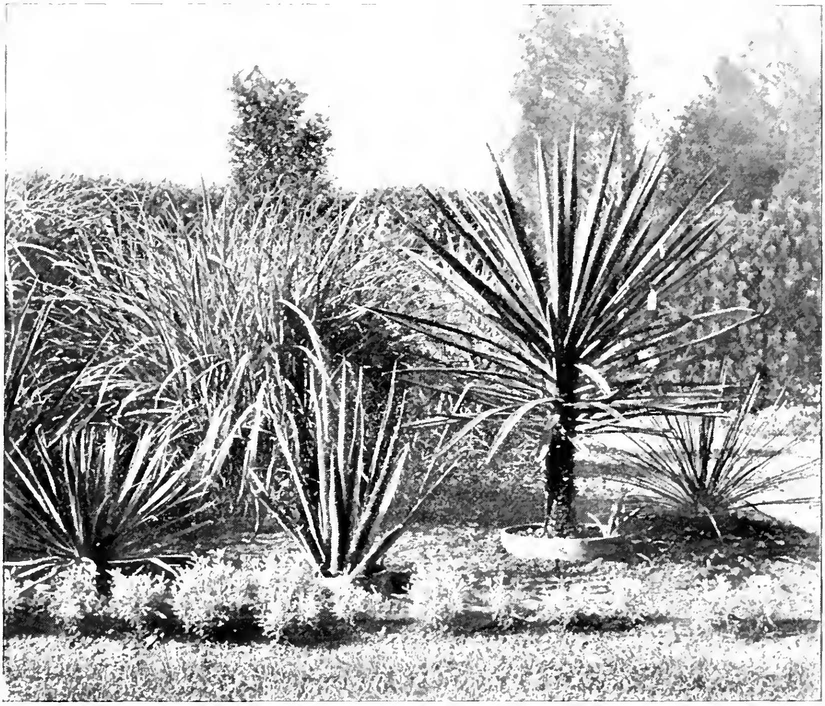

Fig. 3.—Agave Bed. Tree Agave on the Right.

this plant group still holds its own over the rocky hills and mountain sides and barren plateaus, withstanding drought and burning sun, and thriving in the arid sand wastes. And out from their native region many representatives have found their way southward, over into the West Indies, down through Central America, still further to the northern Andes, and almost to the Amazon; and others, though fewer, have come up into our Western plains and mountains, scattered over the Mississippi Valley, and passed through the Gulf States and far up the Atlantic coast. Thus eastward and northward from Texas we can count perhaps a dozen cacti, several yuccas, and one or two agaves, all luxuriating

in their adopted habitats. Such, then, is a general suggestion of the position this plant group holds in our American flora. Let us now outline the relations of its three members to each other and to other flowering plants in general.

It is worthy of note that the three types referred to bear no close relationship to one another; on the contrary, they stand in distinct and rather parallel classes, and each respectively among the most perfect developments of its class. The cacti, on the one

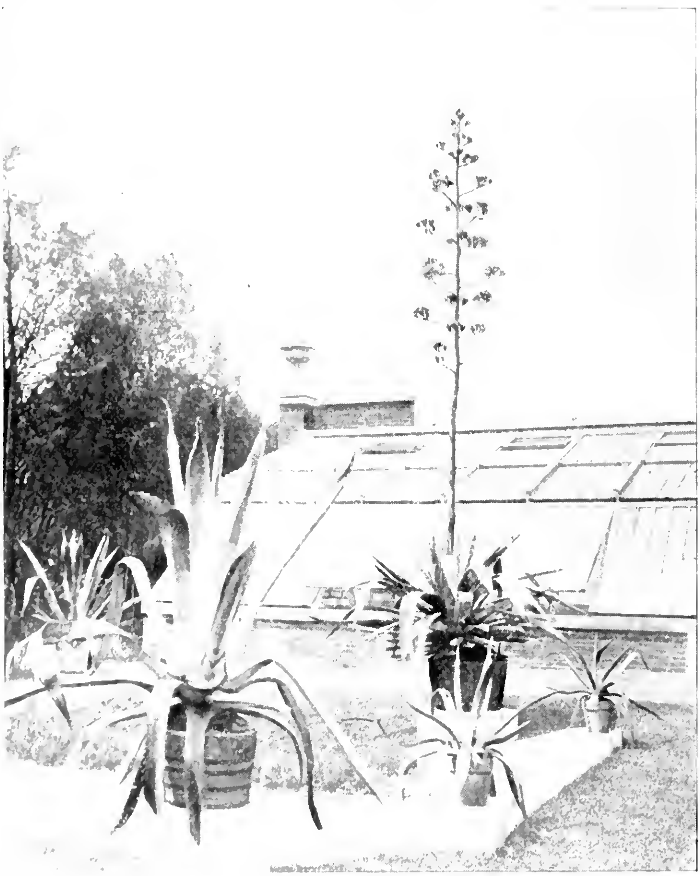

FIG. 4.—AGAVE SALMIANA IN BLOSSOM, AND AGAVE AMERICANA IN FOREGROUND.

hand, hold a place among the most highly organized of dicotyledons; while the agaves and yuccas belong in the other great class of angiospermous flowering plants, nearly parallel, but lower ranked—the monocotyledons. Further, the agaves and yuccas stand in nearly parallel divisions among monocotyledons—the agaves among the epigynous-flowered monocotyls, typified by the amaryllis family; the yuccas among the hypogynous-flowered

congeners of the lily family. Both, moreover, are highly specialized representatives of their respective alliances, and of the two the agaves represent the higher character of development. Thus augmented interest is joined to all three when an outline of their position in the vegetable kingdom shows us that they are to be regarded as almost, if not quite, the highest products of the evolution of that ancient Aztec-American flora whose descendants they are.

And so we are brought to realize that they were worthy recipients of all the attention Engelmann and his co-workers bestowed; and the history of their investigations becomes almost as interesting as the plants themselves. Foremost of all, as has been said, stand the labors of Engelmann; but with him are associated the names of many untiring explorers and enthusiastic botanists, each of whom contributed some vital element to the general outcome: Wislizenus, Emory, Torrey, Parry, Schott, Palmer, Newberry—all were workers in the field, and their names have gone down in the annals of botany appended to one species or another of the genera they studied, fittingly commemorating the aid they gave toward awakening scientific interest in this Southwestern plant group. Engelmann gathered together the work of all and compiled it in his masterly monographs, taking up first the cacti, then the yuccas, and finally the agaves. From time to time he published additional notes, as new store of information came to him, presenting most of the matter to the St. Louis Academy of Sciences, of which he was for years the leading support. Up to the month he died he was working over the great mass of notes he had accumulated on the cacti, preparatory to publishing a grand revision of his first monograph. That the work could not be completed is a source of deepest regret to living botanists; but, nevertheless, the original monograph still stands, and will continue to stand, as the backbone of our knowledge of the family it treats. And as to the other two monographs, the past decade has been able to add little to them of vital importance save in so far as more extended observations have served to more fully develop Engelmann's views. With justice, therefore, is Engelmann accorded a prominent place among scientists; but inseparably linked with his is the name of another man, honored as a broad-spirited patron of science, Henry Shaw, the founder of the Missouri Botanical Garden, on the outskirts of St. Louis. This was the pride of Engelmann's heart, and it was here that he constantly labored under the liberal patronage and never-failing encouragement of Shaw. The two men worked and planned together in their common interest, and as a result we find in the Missouri Garden to-day species of cacti numbering in the hundreds, of agaves more than half a hundred, and the better

FIG. 5.—AGAVE ENGELMANNI.*

* Figs. 5, 6, 10, 11, and 12 are from the Report of the Missouri Botanical Garden for 1892, and Fig. 8 is from the same report for 1893.

part of all the known yuccas, altogether forming one of the most complete collections in the world of these Southwestern types; and he who carefully examines it will be ready to acknowledge it one of the most fascinating of all plant collections. Surely it could have no more fitting home than there in the city of Engelmann; and we can not but cherish the hope that no pains will be spared to make the collection even far more complete than it is, and thus give the American botanist a still greater laboratory in which to investigate so great a factor in American plant life. A suggestion of this aspect of the Missouri Garden may be found in the illustrations accompanying the present paper, most of which are from photographs taken there in July, 1892. The magnificent collection of cacti and the several flowering plants of agave in the World's Fair are of the highest interest in this connection. Can not these form a nucleus for a great permanent cactus garden?

From the general discussion we may appropriately pass to a more detailed sketch of each of the three groups before us, and in taking them up it will be found most convenient to place them in the order of their evolutionary rank: the cacti first, as representing the higher class of flowering plants; then the agaves; and lastly the yuccas, as somewhat lower in station than the second. This will have the merit, in addition to its logical virtue, of disposing of the weightiest group first, and of leaving till the last an amazing little entomological-botanical romance which gathers round the yucca. And the stately agaves will be not inharmoniously sandwiched between their two odd brethren. But let this suffice for a prospectus; the story will tell itself more satisfactorily.

Viewing the three members of our group together, the query presents itself: Is there not some vital significance in the relative extent and diversity of development in these three joint monarchs of the desert? Two of them, those we shall consider later, reach only the magnitude of genera, each constituting a moderate-sized and not remarkably diversified genus; while on the other hand the cacti together form an immense family, the natural order *Cactaceæ*, aggregating over a thousand species, gathered into a number of genera. It is but a grand example of evolutionary principles, "natural selection and the survival of the fittest," for the facts must be interpreted in the light of Darwin's immortal phrase. The yucca pushes its sturdy rootstock through the sand and drinks up each available drop of water; the agave's succulent leaves store up a wealth of nutritious sap: but the cactus seems to be pre-eminently an invulnerable storehouse of life-giving moisture, and the veritable offspring of the arid, rocky sand-wastes, while the others seem only adopted children. Mark the peculiar characters of the typical cactus: The

compact mass of the vegetative body, devoid of leaves or leaf-like appendages, exposes the least possible evaporating surface to the sun; the thick skin, bearing only a few scattered stomata, breathing pores, wraps an almost impermeable covering round the internal moisture; the long, wiry, fibrous roots run hither and thither through the sand and into the finest crevices of rocks; and further, the bristling, spiny armor shields the plant from men and beasts. All this and much more goes to make up the plant of plants that is best fitted to fulfill the mission of vegetation in the Southwestern borderlands. And so the problem solves itself, and we come to realize why the progenitors of the *Cactaceæ* spread out and multiplied far and wide, and broke into a myriad varied forms, all retaining amid their diversity the distinctive characteristics of the primal type.

A standard British encyclopaedia of scarcely three quarters of a century ago vouchsafes the statement that the order *Cactaceæ* embraces "twenty-seven" species. Grasp the contrast between this day of science and that! The botanists of the Century Dictionary estimate the species at far above the thousand mark. For this vast stride we thank a host of indefatigable explorers, and of these, a large share of credit goes to the scientists of the Mexican Boundary and the Pacific Railway Surveys, whose discoveries were the main foundations of the labors of Engelmann. Thus duly recognizing the scope of the field before us, we may with interest follow an outline sketch of the order. The general character of the vegetative body may be passed over for the present without further detail, that we may the more particularly notice the floral structure on which the systematic study of the order so largely depends. The inferior ovary, surmounted by the sepals, petals, and stamens, places the order immediately among the highest of the dicotyledonous *Choripetalæ*. There is a natural division into two suborders. In the first, the *Rotatæ*, the rotate many-leaved calyx and corolla, with the stamens, directly surmount the ovary. In the second there is a unique and obviously progressive development: calyx and corolla are united toward their bases and prolonged into a tube, with the stamens inserted on its throat—whence the name of the suborder, the *Tubulosæ*. The typical *Rotatæ* are the widespread genus *Opuntia*, numbering about two hundred and fifty species. The greater part of the genus are characterized by broad, thickened, fleshy, jointed stems; but a small subgenus, and this probably the less highly specialized, have cylindrical joints. Most of the species are more or less spreading and prostrate, but a large number are truly arborescent in growth. Several species are thoroughly naturalized in the northeastern quarter of the United States, and these are among the most brilliant acquisitions of our

Northern flora. The gorgeous yellow of *Opuntia Rafinesquii* and *O. Missouriensis*, flourishing on a sandy hillside beneath the July sun, can well inspire the soul of botanist and flower-

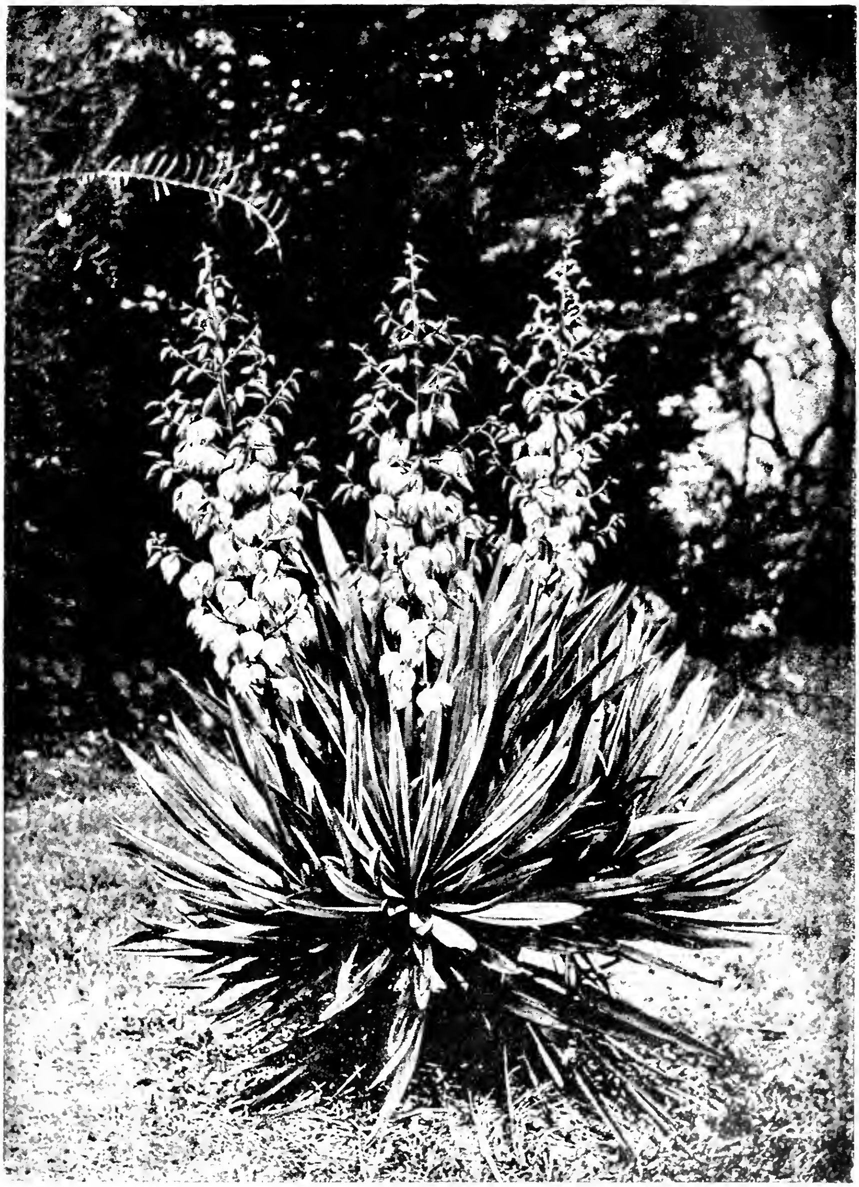

FIG. 6. YUCCA GLORIOSA.

lover. It is an interesting and significant fact that among the *Rotata*, as allies of the *Opuntia*, we find the two little genera that

nearest approach being missing links between other neighboring orders and the *Cactaceæ*, otherwise almost utterly isolated. One is the genus *Pereskia*, in which, especially in *Pereskia grandifolia*, there are developed true leaves, succulent and veiny and with spines in their axils. Most species of the genus are shrubs or trees, and, still further remarkable, the flowers are borne in nearly panicled clusters. The thirteen species belong mostly to the West India region, and one produces the so-called "Barbados gooseberry." A decided analogy may be recognized by close comparison between these *Pereskias* and the *Ribeseaceæ*, the group of the saxifrage family which includes the currants and spiny-stemmed gooseberries; and this probably points to a distant connection between the progenitors of the *Cactaceæ* and those of the modern genus *Ribes*. The other possible "missing link" is the genus *Rhipsalis*, a curious group, mostly epiphytic, and growing in long, pendent masses from the branches of trees, in some instances resembling mistletoe. In these plants we see a possible approach to the group of so-called "ice-plants," the order *Mesembryanthemaceæ*. But most peculiar is the fact that one species of *Rhipsalis* is indigenous to South Africa, Madagascar, and Ceylon—the only instance of an Old World cactus. This probably has its significance.

The other suborder, the *Tubulosæ*, are undoubtedly the more highly specialized cacti, and further, significant fact, they are for the most part Mexican, while the *Opuntiæ* are widely scattered northward. Besides several minor genera of *Tubulosæ* there are three great and distinctive ones, which, as it is interesting to note, mark successive steps in structural specialization—they are *Mamillaria*, *Echinocactus*, and *Cereus*. In mamillaria there is a great departure, in the character of the vegetative body, from the *Opuntiæ*. The plants are more or less globular or subcylindrical, and the original joints of the stem are indicated only by the conical spine-tipped tubercles which make up the surface of the fleshy mass. Echinocactus, the "hedgehog cacti," has the general appearance of mamillaria, but the tubercled surface is modified into a mere series of parallel vertical ribs, bearing clusters of spines along their ridges at points corresponding to the tubercles of mamillaria. Of the two genera, echinocactus is much the more strictly Mexican, while mamillaria has a few representatives spreading northeastward into Kansas and South Dakota. The large genus *Cereus* is the crowning glory of the cacti. It retains the ribbed structure of echinocactus, but its stems are nearly always columnar and in many instances arborescent. With echinocactus, this genus reaches its greatest development in Mexico, or near the boundary line, where flourishes the monarch of the *Cactaceæ*, the "giant cactus," *Cereus giganteus*. In cereus,

furthermore, is the fullest development of the tubular floral structure, much less evident in echinocactus and mamillaria. Thus we find the cacti forming a little kingdom of their own, and could we here go beyond the limits of an outline, a broadly interesting study might be found in each division of the order. But without further detail the vitally important observation may be made, that there seems just reason to believe that what the *Compositæ* are to modern plant life in general, the *Cactaceæ* were, and


FIG. 7.—YUCCA GROUP: 1, Yucca macrocarpa; 2, Yucca treculeara; 4, Yucca elata; 3 and 5, Yucca dasylirion.

probably are, to that ancient Southwestern flora—the climax of its evolution.

Linnæus vividly expressed the spirit of the "century plant" in one Greek word, the very name he gave it—"*Agave*," so called, he said, "because that word indicates something grand and deserving admiration"; and although he only knew a half-dozen species, the many that subsequent research has brought to light justify most fully the title he bestowed. The genus holds a station of its own in the foremost ranks of monocotyledons, but, like the cacti among dicotyledons, rather isolated. It certainly approaches the amaryllis family in many characteristics, and, if really coming within the limits of this order at all, may perhaps

be considered a highly specialized offshoot. There is immense variation in the foliage characters of agave, from the slender

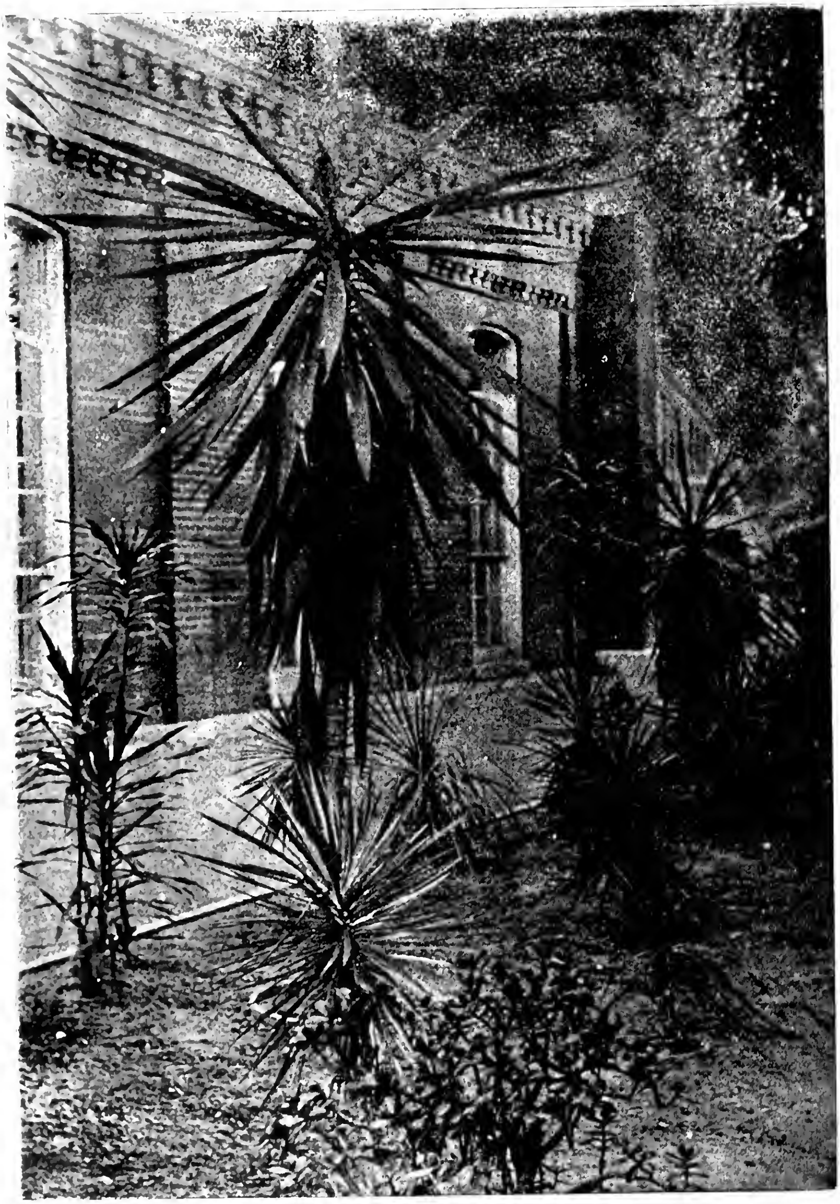

Fig. 8. Yucca Guatemalensis.

reed-like leaves of *Agave geminifolia* to the massive blades of *Agave Americana*. The character of the inflorescence has been

made the basis for the primary division of the genus into three groups: the *Singuliflorœ*, the *Geminiflorœ*, and the *Paniculatœ*. In all cases the flower-scape rises from the apex of the main axis of the plant; all the vital energy of often many years' growth is centered there, and the plant throws up its blossom-stalk as the supreme effort of its existence, and, when the fruit has ripened, dies—a strange phenomenon, and almost without parallel in any other so extensive group. In the *Singuliflorœ* is the simplest type of inflorescence. The flowers are loosely spiked, each one in the axil of a bract. To this group belongs our one Northern agave, the little *Agave Virginica*, which grows from Maryland and southern Indiana southwestward into Texas. The *Geminiflorœ* have the flowers borne in pairs, and densely spiked along the scape. Variations which show transition between both these simpler groups and the third occur. The *Paniculatœ* have the scape more or less branching, often in the fashion of a candelabrum, each branch terminating in a dense cluster of flowers. These are the typical agaves, the crowning glory of the genus. The familiar *Agave Americana* is a representative of the *Paniculatœ*, and so also the plant shown in the accompanying photograph (Fig. 7), *Agave Salmiana*, a magnificent species that blossomed in the Missouri Botanical Garden in the summer of 1892. A splendid agave that commemorates the founder of the Missouri Garden is the *Agave Shawii*, dedicated by Engelmann to Henry Shaw; and in turn the labors of Engelmann have been fitly honored in the dedication to him of a most striking type that he once presented to the Missouri Garden. It blossomed there in the summer of 1891, and when it had been clearly proved a new species it was duly christened by Director Trelease *Agave Engelmanni* (Fig. 5). The structure of the agave flower is extremely unique in several particulars, but further detail can not be entered into. Almost every step taken in the investigation of the genus gives additional emphasis to the first impression, that it is one of the master marvels of plant life.

It remains to add some passing notes on the wonderfully beautiful genus which the lily family contributes to our group, the yuccas. A glorious floral offering to the arid Southwest highlands they certainly are, and scientifically their structure is in many ways scarcely less remarkable than that of the cacti and agaves. But the consideration of these points will be passed over here in order to call up more particularly the phenomenon that makes the yucca an astounding mystery to naturalist and philosopher, the manner of its cross-fertilization. For the fact is, we have here an extensive genus entirely incapable, save under most rarely extraordinary circumstances, of self-fertilization, and entirely dependent on one moth that fertilizes the flowers in order to insure food supply for its larvæ in the ripening seeds. The problem of

yucca fertilization was for many years a vexed question; Engelmann spent much thought and observation in trying to learn its secret, and finally, over twenty years ago, called the attention of Prof. C. V. Riley, the noted entomologist, to certain moths which frequented the yucca flowers. After long and patient study and various erroneous speculations the two scientists ultimately brought the whole mystery to light; and in a recent paper, published in the Report of the Missouri Garden for 1892, Riley has fully elaborated his work of the earlier years and the observations made in the intervening time. The structure of the yucca flower

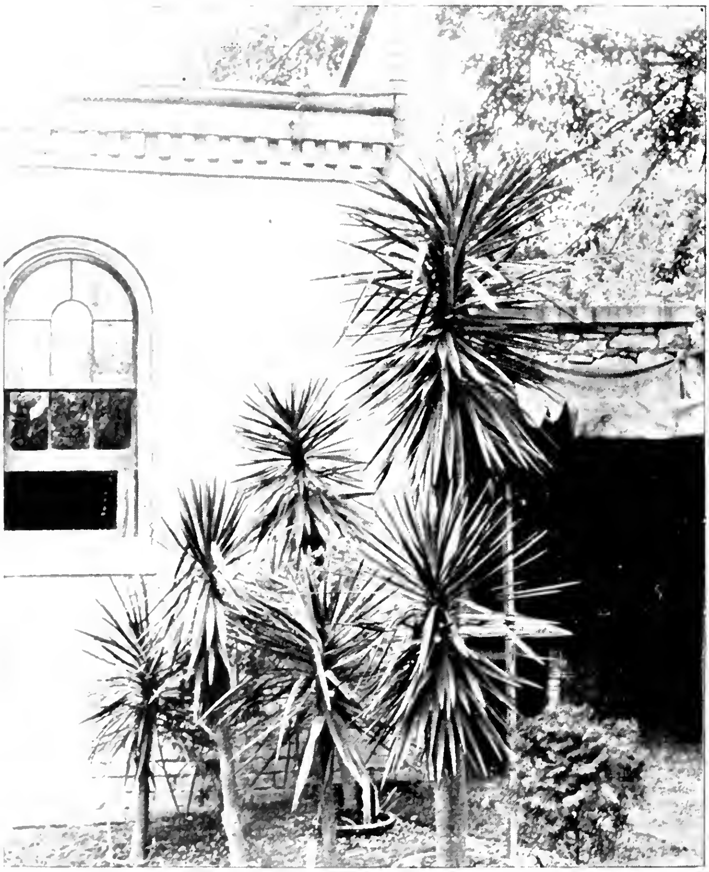

Fig. 9.—Yucca aloifolia.

is plainly outlined in Fig. 10. Long experimentation has positively shown that it is practically impossible for the sticky pollen to be transferred from the little anthers on the tips of the short stamens to the fine stigmatic tube opening only at the tip of the pistil, except by external voluntary agency. As a matter of fact, the agency is

always the little moths of the genus *Pronuba*—never any other insect whatsoever. Several different species of *Pronuba* frequent respectively several different species or groups of species of yuccas,* but the most familiar one is the *Pronuba yuccasella*, always found on our *Yucca filamentosa*, the most Northeastern type. Just about

FIG. 10.—FLOWER OF YUCCA GLORIOSA.

nightfall, as the flowers open, the moths are seen flitting about the yucca panicles. Usually the male is most constantly on the wing, while the female is found running about within the flowers. She begins operations by mounting the top of a stamen, exactly as shown in Fig. 11. There she scrapes with her two odd hook-like maxillary palpi the pollen out of the anther, and rolls it into a globular mass under her head. With this load, often thrice the size of her head, she goes to another flower, runs about, apparently examines every nook and corner of it, and then, if perchance satisfied, finally settles astride two of the stamens with her

* In the Report for 1893 of the Missouri Botanical Garden, Prof. William Trelease, Director of the Garden, publishes a paper on yuccas, from which the following notes are made with reference to the *Pronubas* frequenting different species of the plant: *Pronuba yuccasella* pollinates *Y. filamentosa*, *Y. aloifolia*, *Y. glauca*, *Y. baccata*, *Y. gloriosa*, *Y. elata*, *Y. glauca*, var. *stricta*; *Pronuba synthetica* pollinates *Y. brevifolia*; *Pronuba maculata*, *Y. Whipplei*; and *Pronuba maculata*, var. *aterrima* (a new variety of *Pronuba* discovered by Prof. Trelease in 1892), pollinates *Y. Whipplei*, var. *graminifolia*; and, finally, Prof. Riley predicts the discovery of distinct species of *Pronuba* on each of these yuccas, viz.: *Y. filifera*, *Y. treculeana*, *Y. Guatemalensis*, and others.—H. L. C.

abdomen pressed down between them. From the tip of the abdomen the long, sharp-edged ovipositor, an organ of wonderful delicacy and most remarkable structure, is thrust into the tissue of the pistil, and the eggs are deposited among the ovules. This act may occur several times on the same pistil. Then, still more remarkable, the moth deliberately runs to the apex of the pistil and with tongue and palpi crams a portion of the collected pollen mass into the stigmatic tube, thereby fertilizing the flower. The tongue is worked up and down for some time in the tube like a piston rod, with evident intentness on the part of the moth. This

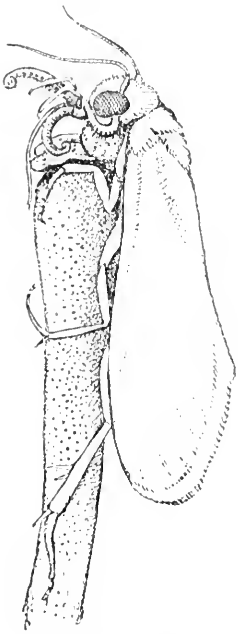

Fig. 11.—Pronuba yuccasella.

Fig. 12.—Fruit of Yucca gloriosa.

series of operations, always in the same order, may be repeated again and again till late into the evening. The moth chooses only the freshly opened flowers and those that have not been punctured by another moth coming before. Only the flowers thus fertilized can ever by any possibility produce fruit; and thus the yucca fruit, as seen in Fig. 12, always bears several constrictions where the scar was made by the puncture of the moth's ovipositor. Inside the fruit the moth-larva develops with the seeds, devouring sometimes a dozen of them; and when the pod ripens the larva eats its way out, and, in the night-time, drops to the ground by a silken thread, burrows into the soil, and there wraps itself in a strong cocoon. Sometimes the moth does not issue

from the cocoon for several years, though not so generally. It is strangely true, however, that moth and yucca flower mature at the selfsame season; and strangest of all, it can not be shown that the moth during its short existence in the perfect state takes a particle of nutriment from the yucca flower—no pollen, no nectar, no stigmatic fluid. This is practically certain. Here, then, is a case of "instinct" that is utterly dazzling; it bids defiance to comparative psychology, philosophy, metaphysics—everything. Here is a plant that can not perpetuate itself without one certain strangely specialized moth; and here is a moth that can not live without that plant; and that moth deliberately cross-fertilizes the flowers without receiving any nutriment from them! Verily, the botanist must rise up and say of the yucca moth what Cicero said of the aged planter of orchards, "Serit arbores quæ alteri sæclo prosint!" and even with greater truth. This is interdependence between the worlds of insect and plant life that baffles understanding.

Cacti, agaves, yuccas, such is the three-typed group that stands out as a great division of a flora distinctively American; unique in the phase of plant development it presents; peculiar to a region of strange physical aspect; sprung directly, for aught that is known otherwise, from the mystery-shrouded soil of the Aztec and the cliff-dweller. And this is the splendid tribute the land of the far Southwest gives to the world of science.

## HOUSEHOLD ARTS AT THE WORLD'S FAIR.

By FREDERIK A. FERNALD.

THE visitor who wishes to learn what the World's Columbian Exposition has to teach in regard to the domestic arts will not find the exhibits in this field gathered in a separate building, as are those relating to Transportation or Agriculture. He will not find them entered as one class in the Official Catalogue, but must search them out in nooks and corners, and will often stumble upon them in the most unlikely places.

To begin with the house itself: two specimen dwellings of low cost are exhibited. Away down near the southeastern corner of the grounds is a neat wooden cottage, forming part of the New York exhibit, and known as the Workingman's Model Home. The house, with cellar, would cost ordinarily $1,000; it measures 20×28 feet, and is designed to stand on a lot of 25×40 feet. On the first floor are a hallway, living room, kitchen, bath room, and storeroom; on the second floor are three bedrooms, each with a closet, and a large closet at the front end of the upper hall. The

house is furnished, and clothing for a family consisting of a man, wife, and three children is hung in the closets. Posted in the several rooms are lists giving the cost of the furniture, the clothing, and the living expenses. The outfit of furniture amounts to $300. The yearly expenses are estimated at $500, apportioned as follows: Rent, $120; food, $200; clothing, $100; fuel, $30; miscellaneous, $50. Experiments in feeding a family of five are carried on in the house by Miss Katherine B. Davis, of Rochester, and the bill of fare for each day since the beginning is posted in the living room. The cost of food for the whole family has ranged between fifty and sixty cents a day.

Just inside the Midway Plaisance stands the Philadelphia Workingman's House. It is a two-story structure of brick, the dimensions being 15×43 feet, and it was erected by the Social and Economic Science Committee of the Woman's Auxiliary of Philadelphia. It contains six rooms and a bath room, has a furnace, and the cellar is concreted. Such a house could be built in most places for $2,300. Floor plans of both this and the New York house can be had for a small charge.

The several exhibits of cooking processes and appliances would make a very creditable display if brought together in one building. Opening from the gallery of the Woman's Building is a large room, where a lecture on cooking is given daily, after which the lecturer spends several hours in answering the questions of interested listeners. This room is called a Model Kitchen in the Official Catalogue, but it is fitted up as a lecture room, and not as a kitchen. The National Columbian Household Economic Association, organized by the Committee on Household Economics of the Board of Lady Managers, provides a lecturer, Mrs. Emma P. Ewing, for two months of the season that the fair is open. She lectured on bread-making during June, and is to return for the month of October. During the whole six months Mrs. Sarah T. Rorer lectures under the auspices of the Illinois Woman's Exposition Board. The board has assigned to her the special task of making known the proper way of cooking corn products to American and foreign visitors, with the object of widening the too restricted market for this product of our soil. Accordingly, Mrs. Rorer describes only dishes into which corn enters in some form. Her list is far from being so narrowly restricted as many might suppose; she has over two hundred recipes available, including breads, puddings of cornmeal and cornstarch, griddle cakes, mushes, hominy, blanc mange, and (not to be omitted) Philadelphia scrapple. A selection of these is included in the little recipe book given away at the lectures. Mrs. Rorer also gives lessons to a class of girls, the purpose of which is to show how cheaply instruction in cooking may be introduced into public schools.

Returning now to the southeastern corner of the grounds, we find close to the Anthropological Building a small structure devoted to demonstrations in cookery. Owing to various obstacles it was not opened until about August 1st. These demonstrations form part of the Massachusetts exhibit. They are conducted by Miss Maria Daniell, under the general direction of Mrs. Ellen H. Richards, Instructor in Sanitary Chemistry at the Massachusetts Institute of Technology. The building is called the Rumford Kitchen, after the scientist of Massachusetts birth who did so much to advance the art of cooking just a century ago. Selections from three classes of dishes are prepared and served: namely, soups, luncheons for school children and students, and foods for the sick. Leaflets containing instructive matter are distributed, but no set lectures are given.

Beside the Rumford Kitchen stands another small building, also devoted to the teaching of cookery, and opened about the same time as its neighbor. This is a part of the New York exhibit, and is in charge of Miss Juliet Corson, the head of the New York Cooking School.

Considerable evidence may be found that cooking is being made a subject of school instruction in this and other countries. In the educational exhibits of the several States, which are placed in the gallery of the building of Manufactures and Liberal Arts, this subject is included in the school programmes of many cities and towns, and some pictures of classes at work are shown. From the gentleman in attendance at the educational exhibit of Japan the writer learned that domestic economy is taught in the schools of that country. In the German section of the Woman's Building is an alcove containing utensils, charts, and models of buildings used by the people's kitchen schools, household schools, and homes and schools for servants in Germany, with statistics concerning these and related institutions. This exhibit was prepared by Frau Lina Morgenstern, of Berlin. Near by may be found information concerning the housekeeping and other schools maintained by the Ladies' Societies of Baden, with pictures of the schoolrooms.

When we look to see what articles of home cookery have been sent for exhibition we find that the catalogue of the Woman's Building mentions fig preserves, other preserves, jams, jellies, home-made wines, and catsups, sent by four exhibitors, as being in the lecture room, but a diligent search in that room fails to reveal them. In the exhibit of woman's work in the Illinois Building, made under the management of the Illinois Woman's Exposition Board, is a neat case in which the Chicago Exchange for Woman's Work exhibits preserves, jams, jellies, and several kinds of pickles, very attractively put up. Preserves and jellies put up by women may also be found in the North Carolina section of

the Agricultural Building and in the Florida and Colorado sections of the Horticultural Building. In the latter building also is a large and varied assortment of apple jellies, each kind bearing the name of the variety of apple from which it was made, exhibited by a Maine woman. Across the avenue, outside the fair grounds, is the interesting exhibit of Manitoba. Here may be seen a large collection of preserved fruits and preserved and pickled vegetables, all put up by women in their homes.

The food stuffs, and especially the partly prepared foods exhibited by manufacturers, are numerous and varied. Most of these are placed in the gallery of the Agricultural Building, but there are a few important exceptions. Butter and cheese are to be found in the Dairy Building, coffee and tea in the foreign buildings or foreign sections of the large buildings. A great part of the exhibit in the Brazil Building consists of coffee, and this product is shown also by other countries of South and Central America and the West Indies. In some of the buildings a cup of the beverage may be had. Ceylon tea is served by Cingalese attendants in the Ceylon Court and in three or four of the general buildings. Four of the prominent chocolate manufacturers have separate small buildings in various parts of the grounds, and another has an attractive exhibit in the Agricultural Building. At all of these chocolate and cocoa are served. In the main food display the great packing houses exhibit canned, smoked, dried, and salt meats, canned fish and shell fish, mince-meat, lard, extract of beef, and canned soups. An English firm has gone one step beyond the canned soups and sends desiccated soups. Butterine or oleomargarine is shown by several manufacturers, and accompanied by clear and frank statements of how it is made and what it may be used for. Mixtures of beef suet and cotton-seed oil, under the names of vegetole, cotosuet, and cottolene, are offered to take the place of lard. The value of rice and rice flour as food is well shown in the Louisiana section of the Agricultural Building. Brands of salt which are declared to withstand the attacks of "General Humidity" are exhibited in this building and in the Mining Building. In the inventions room of the Woman's Building are evaporated vegetables and sweet-potato flour prepared by a process which was invented by a St. Louis woman. Condensed milk and evaporated cream, baking powders, gelatin, fruit butters, pickles, and catsups are among the many other foods shown by enterprising manufacturers. At many of the food booths visitors are invited to taste the foods, and are requested to register their own names or those of their grocers.

There is no lack of appliances and utensils for cooking. The ranges are too numerous to mention, but a few unusual features may be noticed. One make has a round iron plate on the floor of

the oven which revolves easily when it is desired to turn a pan that is set upon it. Another has a round piece cut out of the upper side of each cover and held in place by screws, its object being to prevent cracking. Still another has one cover made up of concentric rings so as to furnish five different-sized holes. Mrs. Rorer exhibits at her lectures a range having a perforated oven door lined with wire gauze. This, she says, enables meats to be really roasted in an oven instead of being baked. A range with which is combined a hot-water house-heating apparatus, the invention of a Chicago woman, is also shown in the lecture room and in the Manufactures Building. A long line of cooking apparatus for gas is shown, at one end of which is a simple hot plate and at the other a range with baking oven, broiling oven, dish warmer, and water back. The larger ranges have a flue to carry off the products of combustion. There is also a variety of gasolene and kerosene stoves. One novelty in this line is the parlor-lamp stove. It consists of an ornamental tripod supporting a top on which the cooking is done, an ordinary large parlor lamp being placed inside the base. When used for lighting, the lamp is set on top of the tripod. Among the kitchen appliances used in the New York Workingman's Home is the Aladdin oven, invented by Mr. Edward Atkinson, and fully described in this magazine about four years ago.

The greatest novelty in cooking appliances at the fair is unquestionably the apparatus for cooking by electricity, shown in operation in the gallery of the Electricity Building. The electric current is conducted into plates of enamel, where it meets with resistance and is converted into heat. These plates are attached to specially constructed ovens, broilers, griddles, flatirons, etc. An ordinary stewpan, coffee or tea pot, or steam cooker may be heated on the "disk heater." An outfit of articles necessary for a private house costs $60, or $77.50 if a heater for a kitchen boiler is included. Electricity has the same advantages over coal that gas has; its advantages over gas depend upon the fact that combustion, with its needs and limitations, is wholly done away with. There are no products of complete or accidentally imperfect combustion, there is not even a slight loss of heat into the room or up the flue. The strongest points of electrical cooking are comfort and convenience, but claims are made for it also on the score of economy. It is said that the cost of cooking by electricity is less than the cost with coal and about the same as where fuel-gas is used. This is on the supposition that the electricity is furnished at half the price charged for lighting.

Kitchen utensils are no less well represented than are stoves and ranges. The main exhibit of these is in the Manufactures Building. Among them may be mentioned stamped ware enam-

eled in granite and other colors; spiders that will suit both right-handed and left-handed cooks, having a lip on each side; two forms of "self-basting" roasting pans, designed to prevent meats from drying in the oven; knife-edge, torsion, and spring balances; and cast-iron ware polished and even nickel-plated. Portable ovens for gas and kerosene stoves also steam cookers jacketed with asbestos are shown. The jacket prevents the conduction of heat from the cooking food, thus utilizing a scientific principle which is too commonly disregarded in cooking. Cylindrical tin receptacles for flour and meal are shown which may be fastened against the wall at a convenient height. The flour is made to pass through a sieve by turning a crank and comes out by an outlet at the bottom. A measuring cup, which fits on to the outlet when not in use, forms part of the apparatus. There are quite a number of machines worked by a crank which save a great deal of tiresome and time-consuming hand work. One company exhibits a meat chopper, a fruit press, a sausage stuffer, and a cherry stoner. The same company makes a simple utensil, like a saucepan in form, for shaving ice. Another exhibitor has a little nutmeg-grater that is worked by a crank. A small room in the Woman's Building is devoted to inventions by women. Most of these are household articles, while some are of a wholly different character. These inventions are generally modifications of articles already in use, novel departures being rare. Among the cooking utensils in this room are a metal kneading-board, a kitchen knife especially adapted for slicing, a frying pan with a hood and a flue to carry the smoke from the food down into the fire, and an egg and cake beater with a new form of stirrer. Another cake beater invented by a woman, and resembling the tin flour bin described above, is shown in the Agricultural Building. Inventions by women appear also in the Illinois Building, among them being a funnel, a baking pan, and a kettle holder for a stove. A fruit evaporator small enough for household use is shown in the Horticultural Building. The capacity of the smallest size is about half a bushel of apples. In the same building a German exhibitor shows knives of peculiar shapes, for paring and slicing vegetables and cutting them into ornamental shapes; also a cherry stoner. Household woodenware is to be found in the Forestry Building; one make has electrically welded flat hoops set in grooves in the staves, instead of the common riveted hoops; another has welded wire hoops which are imbedded in the wood at several points in the circumference. Near by are shown tubs, pails, keelers, bowls, milkpans, measures, etc., of indurated fiber (paper pulp), which are molded in one piece.

But few appliances are required for laundry work, hence the exhibits in this line are not conspicuous. Of course, wringing

machines are no novelty, but one whose good points are actively exhibited by an attendant attracts considerable attention. It can be put on or taken off the tub with wonderful ease, and adjusts itself to any article from the thickness of a handkerchief up to that of a door-mat. A washing machine for domestic use, shown in the Forestry Building, consists of a round, covered tub with a corrugated bottom and having an axle passing through the cover. The axle carries a corrugated disk on the lower end and is turned by a crank at the top. In the Machinery Building a German invention may be seen. Its tub is three or four feet high and stands on a low frame. It is worked by pushing a lever back and forth. This action turns the drum containing the clothes, and rotates in the opposite direction a stirrer shaped like a four-legged stool. The "self-heating" washer has a box-shaped tub set on legs. Inside is a washboard hung horizontally from a frame, which is pushed back and forth upon another similar board by a long handle. The tub has a metal bottom to which a flame can be applied by means of a gasolene attachment. This attachment can also be swung out and used for making starch or heating a flatiron. One of the most creditable of women's inventions to be seen is the well-known "cold-handled sadiron," with a detachable handle. Another woman's invention for the laundry, shown in the Woman's Building, is called a "convertible chair," and is described as a combination of clothes rack, ironing board, clothes receptacle, and bosom board. Still another is a waist and sleeve pressing board. Plain laundered articles are shown in the exhibit of the London Board Schools, each piece being marked with the name and age of the girl by whom it was done up. The Lette-Verein, of Berlin, also exhibits laundered articles in the Woman's Building.

One branch of domestic economy which is finely illustrated is the care of children. In the western end of the Children's Building is a large room occupied by the Fitch Crèche and Training School for Nursery Maids. It is fitted up with bassinets and cribs of various styles, one crib being suspended from the ceiling, while on the floor is a square inclosure in which a baby may be safely left to creep about without watching. Here a class of girls is learning the proper care of infants under competent instruction, and here mothers may leave their babies to be cared for through the day while they are seeing the fair. The crèche is an exhibit of the Kindergarten Society of Buffalo. Let no one imagine that sightseers are allowed to wander at will through the room; they can only look in through a glass partition. The middle of the Children's Building is occupied by a gymnasium and there is a playground on the roof, each being suitably fitted up. On the second floor are several rooms in which kindergarten, sloyd, and

other classes are taught. Children's books and papers are shown in the library. In connection with the rearing of children it is perhaps appropriate to mention a collection of photographs of children whose mothers have gone through college, shown in the British educational exhibit. This in refutation of the assertion that college education unfits young women for motherhood.

Ornamental needlework occupies much space at the fair, but useful articles made with the needle are few. In the woman's room of the Illinois Building is a large and attractively arranged case of children's clothing, called the Lilliputian bazaar. Here and in the Woman's Building are a number of women's inventions to facilitate needlework. The women of Manitoba, together with their embroidery and fancy work, send a creditable display of plain sewing and knitted articles. A similar exhibit comes from Uruguay, and, strange to say, is placed in the Agricultural Building, in the space assigned to that country. It is evident that sewing is being made a subject of school instruction in many parts of the United States and also in other countries. The various educational exhibits contain many samples of sewing and mending done by schoolgirls, and the subject is mentioned in a large number of school programmes. Samples of simple millinery, as well as of sewing, appear in the exhibit of the Workingmen's School, of New York. Plain needlework may be seen in the educational exhibit of Japan; also in that of the Board Schools of London. The exhibit of the Lette-Verein, already mentioned, includes plain and ornamental needlework, dressmaking, and millinery.

A few exhibits of a miscellaneous character remain to be mentioned. Three concerns show reversible window sashes, which may be turned into the room, permitting the outside of the glass to be cleaned without discomfort or danger. Among the women's inventions is a wooden roller, covered with some rough material like Turkish toweling, and designed to take up dust from carpets or hard-wood floors. It may be attached to a carpet-sweeper or trundled by a handle independently. With one of the exhibits of domestic hardware in the Manufactures Building is a water motor for driving sewing machines, fans, ice-cream freezers, etc., in any house that has a water supply. Small electric motors adapted to the same purposes are shown in the Electricity Building. These can be used wherever electricity is supplied for lighting, and some are made to be run by a galvanic battery. The water motor can be set in motion and stopped by turning a faucet, and the electro-motors by turning a switch. An interesting application of a scientific principle is seen in a cooler for food, beverages, and provisions, which the agent of a Belgian inventor has placed in the Machinery Building. It is in the form of a high dish cover, is made of tin, and covered with a cloth jacket. The jacket is kept

wet by dipping into a moat containing water, and the constant evaporation from the cloth produces the cooling action of the apparatus. One of the schoolrooms in the Children's Building is a "Kitchen Garden," in which housework lessons with toys are given to very young girls. Its aim, as stated on its placards, is "to take the drudgery out of so-called menial work and elevate the home duties of women by inspiring the pupils with the right way of doing things at an age when life-long impressions and habits are formed." The lessons include waiting on the door, passing a tray, bedmaking, and a broom drill. There is an advanced course for older girls which includes cooking and laundry work. The originator of the Kitchen Garden is Miss Emily Huntington, of New York, who may be consulted daily upon the organization of industrial classes for girls.

Domestic economy has not been omitted from the list of congresses held in connection with the fair. Its congress will be held in the second week of October, under the direction of the Woman's Committee on Household Economics, in the Woman's Branch of the World's Congress Auxiliary. This committee has also been charged with the duty of presenting its subject in the agricultural, labor, sanitary, and other congresses. Unfortunately, more than half the usefulness of all the congresses has been thrown away by holding them seven miles from the center of attraction and in noisy surroundings.

After everything relating to household management has been sought out, the visitor can not resist the conviction that the exhibits at the Columbian Exposition fall very far short of what they might have been and should have been in justice to the importance of the subject. Two of the excellent exhibits of cooking processes are placed in an out-of-the-way spot. Few products of home cookery are shown, and nothing except preserves. Domestic laundry operations are not illustrated at all; laundered articles are sent from schools in England and Germany, but nothing from any American school, and no American woman has shown her skill in washing flannels without their shrinking, colored goods and embroideries without the colors running, or in putting a gloss upon starched linens. In needlework the ornamental has buried the practical out of sight. The difference between the right and the wrong way of making a bed, of sweeping and dusting a room, of cleaning windows and woodwork, and of setting and decorating a table, might all have been illustrated to the great profit of many thousands of visitors. The difficulties in the way of such exhibits are no greater than those that have been overcome in other cases. According to the census, more than half the men of the United States engaged in gainful occupations are occupied with agriculture; and this industry is adequately represented in its

special building and in many of the Western State buildings. An even larger portion of the women of this country are occupied in home management, and it might have been expected that, under the direction of the Board of Lady Managers and in the Woman's Building, some systematic representation of this important occupation would be found. But no; the women of America have preferred to be represented by their painting, their books, their embroidery, their societies for inducing other people to become wiser and better, their work as hospital nurses, by paper lamp-shades and indescribable things in cardboard and colored wools—by anything, in fact, that is either pretty on the one hand or mannish on the other, or is remote from every-day affairs. This criticism must not be taken as evidence of a wish to restrict women to housework alone. The real feeling of the writer can not be better expressed than by the following words from the preliminary address of the Woman's Committee on Household Economics: "It is not necessary to consider whether woman's sphere is limited to her home—it concerns us to so improve the work done in the home that out of it shall come a power so well trained, by careful study of scientific and economic principles, that it will facilitate and lighten, as well as dignify, household labor."

## THE PROBLEM OF COLORED AUDITION.

By M. ALFRED BINET.

MUCH attention has been given lately to the subject of colored audition. It has been discussed in daily journals and in literary and scientific reviews; in medical theses, memoirs, and didactic treatises; it has figured in poetry and romance, and on the stage; it has been the occasion of many inquiries; and physiologists have occupied themselves with it and made laboratory experiments on it.

Notwithstanding all investigation, the subject is still imperfectly known and understood. It has been studied mostly from without. The details concerning the sounds and the associated colors have been carefully noted, but no one has told what colored audition is, or has made it intelligible to those who know of it only from others. We can not hope to be much more fortunate than our predecessors; but we shall direct our attention to the points they have overlooked, and shall try to describe a mental state in colored audition. Let us point out first, in order to gain a comprehensive view upon these questions, the circumstances under which a person first perceives that he has the faculty, as it has been called, of coloring sounds.

Those who for the first time hear these perceptions spoken of experience great astonishment. They can not gain a clear idea of them; the comparison of a sound with a color seems to them wholly destitute of intelligible character. Meyerbeer has said somewhere that certain chords of von Weber's music are purple. What does the phrase mean? Each of the words, taken by itself, has a meaning. We know what a chord is, and we know purple; but joining the terms with a verb and saying the chord is purple, is something we do not understand. As well say virtue is blue and vice is yellow; one is ready to ask if the construction of such phrases is not a trickery of words, which are brought into purely technical associations corresponding to no real association of thought.

Thus, to the immense majority of persons, colored audition is a riddle. This is one of the reasons why the world for a long time refused to believe in it, and treated as eccentrics those who concerned themselves with it—a skepticism which was all the more justified because the matter related to a subjective condition, the existence of which has to be accepted on the simple word of the person who experiences it.

We do not know whether we can make the true nature of this phenomenon understood, or whether we can help those who have not experienced it to conceive of it; but we hope to be able to demonstrate that it is real. Deception has generally an individual character; it is the work of one person and not of many; it gives no occasion for massed effects which are repeated from one generation to another, and in different countries. The number of persons who say they have colored audition must be taken into consideration. According to Bleuler and Lehmann, it is twelve per cent. M. Claparède, of the University of Geneva, who is now investigating the subject, writes us that of four hundred and seventy persons who answered his questions, two hundred and five, or forty-three per cent, had colored audition. Of course, this proportion can not be taken literally, for the immense majority of the persons who do not experience the phenomenon will not answer the queries for many motives, the chief of which is a kind of contempt for studies they do not comprehend. It is nevertheless true that M. Claparède has collected, without great effort, two hundred and five observations, and that that number, added to the old observations, gives a total of nearly five hundred cases. Such a mass of observations may well inspire some confidence. It may be added that each of the authors who have written on the question often has by him the observation of some friend in whom he has entire confidence; so that resistance to so many accumulated proofs becomes no longer wisdom, or even skepticism, but simplicity.

The first author who noticed the production of impressions of color by sounds was an albino doctor of Erlangen, named Sach, who in 1812 described in an inaugural thesis his own impressions and those of his sister. His observation is very complete, and contains a considerable proportion of the details which are found in later works. He died at the age of twenty-eight years, and his researches fell into oblivion. During the following years doctors and oculists, like Cornas, of Geneva, published isolated observations.

In 1873 appeared the important observations of the brothers Nussbaumer, one of whom was a student at Vienna, and the other a watchmaker; both of whom had from childhood experienced sensations of color when they heard certain sounds. When children they observed the ringing of spoons and knives tied to the ends of strings, designated the colors produced by the sounds, and communicated their impressions to each other; but they did not always agree concerning the colors of the different sounds, and long disputes ensued, of which their brothers, sisters, and friends could understand nothing. The student afterward published, under the direction of Prof. Brühl, a detailed memoir on the cases.

Six years afterward, in 1879, Bleuler and Lehmann wrote their memoir, the most complete one we possess. Both authors studied medicine at the University of Zurich; Bleuler writes concerning the origin of this work that they were talking of chemistry, when the subject of ketones coming up, Bleuler remarked that they were yellow, because there was an *o* in the word. Thus by a curious illusion he attributed the colors suggested by the name of an object to the object itself. His friend Lehmann, greatly astonished and not understanding the answer, asked for an explanation of it. This stimulated his curiosity, and they both proceeded to make inquiries among their relatives and friends. They published accounts of more than sixty cases.

From that time publications multiplied, and the present period is marked by investigations pursued in every direction. It now appears that colored audition belongs to a family of similar phenomena, which are sometimes grouped in one person and sometimes scattered. Colored audition is still the most frequent and best studied phenomenon, and is the single one which we intend to discuss. But a word should be said of the other forms. They differ chiefly in the nature of the impressions that are associated, and which serve reciprocally as excitants. Thus, in some persons, not sounds but sensations of taste and odor provoke the luminous impressions. These may be called colored gustation and olfaction. In others, psychical phenomena, like recollections or abstract notions, produce the same effect. One person sees colors in the months, in the days of the week, or in the hours of the day. In

other persons the impression is not visual, but may belong to a different sense. It may be sonorous; in some persons the sight of colors gives a musical impression: or it may be tactile, and sight and hearing may be accompanied by mechanical sensations. In short, all imaginable combinations of different sensations may be realized.

In colored audition the impressions of color are almost exclusively provoked by speech: the sounds and noises of Nature producing the same effect only by a kind of analogy with the human voice. Speech gives him who hears it an impression of color only when the emission is full; a murmur has not the effect of the singing voice or of a reading in public: the height of the tone influences the shadings: barytone and bass voices excite dark sensations and high voices light ones. On a closer examination of the source of the phenomenon it is found that the color, while it may borrow a general tint from the timbre of the voice, and consequently from the individuality of the speaker, depends more especially upon the words that are pronounced; each word has its peculiar color, or we might rather say colors, for some words have five or six; pushing the analysis further, we perceive that the color of words depends on that of the component letters, and that it is therefore the alphabet which is colored: and, finally, that the consonants have only pale and washed-out tints, and the coloration of language is derived directly from the vowels. With a few exceptions this is true for all the subjects.

By a curious complication produced by education, the appearance of colors takes place in some persons not only when they hear the word pronounced or when they think of it, but even when they see it written. There are also persons who do not perceive the color except while they are reading. Many facts, however, seem to prove that reading is generally of no effect except as a suggestion of the spoken word, and therefore constitutes a kind of audition.

The observations on the colors of the vowels in detail are irregular and contradictory. Thus, *a*, red to one, is black to another, white to a third, yellow to a fourth, and so on; the whole spectrum passes through it; but as the number of colors and of letters is limited, we can, by analyzing a hundred observations, meet two or three among them that will agree. Sometimes agreement is manifested between members of the same family, or between persons who live together; but waiving the instances afforded by chance, by heredity, and by suggestion, it remains evident that disagreement is the general rule; and from this curious practical effects follow. Two persons having colored audition, when brought together, are not able to understand one another: each is greatly surprised at the colors which the other perceives, and we

may witness, according to certain authors, some most amusing disputes. Efforts have been made to trace a mean of designations for the vowels, and to indicate the associations most frequently perceived. It is very doubtful whether such statistics can give important results, and whether the correct association can be got from the majority; for the probability must be recognized of the existence of several types of colored audition, which have not yet been clearly distinguished. Furthermore, persons are most frequently incapable of exactly determining and defining the color that appears to them. Their incapacity is associated with the facts that the shading varies not only with the words, but with the elevation of the voice that pronounces them, its timbre, and its accent. A word never has the same color from two different mouths. Consequently there is no definite red for *a* or for any other vowel. Some authors have nevertheless published colored diagrams in which the subjects have tried to represent their colored alphabet. These representations may hold good for colors, but not for shades; it is not that the subjects are lacking in good faith, but they can not fix with precision a color that oscillates and is transformed under the influence of a multitude of intangible causes. We can not stop with describing the phenomena, but must explain as far as we can what passes in the minds of the persons who experience impressions of color in connection with sound. What do they mean when they say, for instance, that *a* appears red to them?

Persons affected with colored audition form a curious illusion respecting their psychological condition. Till the moment, when they are questioned respecting their impressions, they are satisfied that the faculty of coloring sounds is natural, normal, and common to all; and they learn the contrary not without uneasiness. One is never satisfied if he knows that he possesses, deep in his mind, an exceptional trait. All of this kind that is exceptional seems abnormal, and assumes the character of a disease. This opinion is that of many doctors, who would often have much difficulty in defining the condition of psychological health, but imagine that whatever departs from that ideal and imperfectly understood condition is in the domain of pathology. Numerous authors who have written on colored audition have been laudably zealous in comforting those who perceive these impressions. Most—not all of them—have affirmed many times that it is a purely physiological act. We believe they are fundamentally right—but how far?

The phenomenon is often presented in an inexact light. It is easily understood now that it is not a disease of the eyes or the ears, but many authors continue to see in it a disorder of perception, or a double perception, or a confusion of the physiological acts of seeing and hearing.

In colored audition there is no double perception, nor what is called a synæsthesia. All takes place in the imagination of the subject; the impressions of color of which he is conscious on the hearing of certain vowels are not real sensations; they are not colors which one sees with the eyes, but mental images, notions, or we might better compare them with the images which the natural significance of the words excites in the mind. We must insist upon this important and too often misinterpreted point. In order to give a basis to our interpretation, we shall relate some of the facts we have collected with Prof. Beaunis in the Laboratory of Psychology of the Sorbonne; we shall not introduce the detail of the observations, but shall only take the general sense.

To a certain distinguished doctor *a* is red, and is the only vowel which appears to him in color. He has colored it spontaneously from infancy, before having read what was written on the question. The other vowels were not colored till a later age. He is suspicious of the later colorations, and believes that they are fictitious, suggested by reading. Now, what meaning shall we attribute to his expression, so clear in itself, "*A* is red"? Does he mean that when he sees the letter *a* written with a pen on a white sheet of paper, or with chalk on a black tablet, or when that vowel is pronounced in his presence, he has the subjective impression of a red spot which hovers before his eyes, on surrounding objects? In other words, is there a hallucination of sight? In no wise. Still less is there the pretended and incomprehensive seeing of the sound in red. He has the idea of red, and nothing more. It is an idea and not a sensation. According to his own expressions, he receives the same suggestion when he meets in any phrase the word red. Hear, for example, a person who is telling us of some judicial ceremony. In the midst of his story appears the phrase, "Then I saw the procurator rise in a red robe." We have immediately an internal vision of something red—a vision clear, detailed, vivid for some, confused for others. It is a like impression that the letter *a* gives our subject; in short, a simple idea. Let us add that the idea is not very clear; the subject can not define the shade of red that appears to him, still less represent it in real colors, even if he knows how to mix colors and is an amateur painter; it is some kind of a red—unprecise.

If we suppose, now, that all the vowels give rise to suggestions of a similar character, our description will be adapted to a majority of subjects; it will exactly represent their mental state. This mental state is characterized by the direction of the thought toward colors and shades. Each word that presents itself, whether to the eyes in reading, or to the ear in listening, or in a mental conception, gives complex ideas of color. These ideas serve as an escort to the word, accompanying it constantly, and are a second-

ary signification with which the word is enriched. Instead of provoking a single idea, each word provokes two—the idea of the object named, and one or several colors; likewise a phrase awakens, besides a collection of images, a series of colors. On hearing the simple words, "I am going into the country," a person with colored audition has a complex image of a trip to the country, and sees besides passing before the eyes of his imagination a succession of colors which in a subject taken at random might resolve itself into white, red, black, red, white, red, red, red, red, white.

This description may lead us to suppose that useless suggestions of color are an obstacle to the march of thought and might sometimes prevent persons from clearly comprehending the meaning of words and of reading. This case, fortunately, has not as yet presented itself; for the bands of colors do not constantly hold the first place in consciousness. When it is necessary to attend to the meaning of the words we neglect the colorations, do not remark them, and no longer perceive them. To perceive them clearly, and particularly to describe them, special attention is usually requisite, contemplation, a state of reverie, or a desire to enjoy the beautiful subjective colors, the appearance of which is usually accompanied by a vivid feeling of pleasure.

Besides the vague, undefined, and formless color-images which are most frequently provoked, the color is perceived by many persons in a form suggested by the vowel and corresponding with its outline. The language commonly used by such persons to describe their impressions does not always take note of this peculiarity. They simply say, "*A* is red." This means, in the present case, that when one thinks of the letter *a* he can not represent it otherwise than under the form of a letter painted in red. This variety of colored audition is more refined than the preceding, and also more complex; for it can not be found in an illiterate person, and supposes that one knows how to read. Mr. Galton has published five or six observations of this kind with figures.

Persons who have colored audition and who are cognizant of it easily recognize the nature of their subjective impressions. They regard them as personal associations with nothing mysterious about them, and some even seek for their causes in the most commonplace and trivial circumstances. But if we cause them to describe their way of hearing, we perceive that they involuntarily attribute to these associations much more importance than they say they do. It appears that most frequently the idea of color suggested by a word is referred, not to the word itself, but to the external object designated by the word. There results from this the interesting consequence that as there are words designating some object of a red color which, on the other hand, provoke by

their vowels the idea of a different color—for example, gray—the discord appears shocking, and the subjects do not hesitate to declare the word ill-formed. A doctor, a friend of ours, to whom *a* (French) is red, finds also that the word *feu* (French for fire) is incorrect, because fire is red and the word *feu* has no *a*. A correspondent to whom colored audition is a multicolored palette makes similar remarks on the contradictions or confirmations which he finds between words and their colors. To him *a's* are red, as to the doctor; hence he finds that red (*rouge*) is ill-named, and that the word fire (*feu*) is "that which is dullest"; scarlet (*écarlate*) is, on the other hand, quite imitative. *I* is black and *o* is white; whence it results that the word *noir* (black) is white and black; to pronounce the words *moire rouge* is to think of a contradiction. These plays with words, of which we might cite numerous examples, seem to us to indicate a tendency to give a real significance to associations of sound and color, as if they expressed a truth to which language ought to conform. But the subjects are too intelligent to affirm this; they simply yield to the sway of thought, without being aware of it.

There are other persons in whom the same tendency is manifested in a clearer and more simple way. They believe in good faith that certain things they have never seen have precisely the color of the word by which they are named. We have mentioned Bleuler, for example, who thought the ketones were yellow, because of the *o* in the name, to which he attributed that color. Observations of this kind need not be enlarged upon. For a person to believe that a thing is red because there are red vowels in its name, he must not be acquainted with its real color, and must not be aware of his faculty of coloring the vowels; for the illusion will disappear as soon as he perceives that the supposed color depends on the word. These are probably the conditions of the following observation of which I have been informed by M. Claparède. A person fifty-two years old wrote to him: "I still remember the astonishment I felt at the age of sixteen years when I saw sulphuric acid for the first time. I had previously read an account of that substance in a work of popular science, and had fancied it an opaque liquid, having the appearance of tarnished lead. I was then not yet conscious of my colored vision of the vowels. Later in life I explained my fancy as related to the two *u's* in the word sulphuric." This person saw *i* as black, and *u* as a lusterless metallic gray.

The same tendency, but with a very different effect, appears in a lady observed by M. Suarez de Mendoza, who attributes a special color to each piece of music and each score. The music of Haydn appears to her of a disagreeable green; that of Mozart, generally blue; Chopin's is distinguished by much yellow;

Wagner's gives the feeling of an atmosphere of light, changing its colors in succession.

Having established the mental nature of the impressions of color, we come now to seek the cause of their apparition. We know pretty well what one means when he declares that *a* is red; but we have not explained how the idea or perception of a sound can awaken the idea of a particular color. Our ideas have generally a logical origin; we are at least in the habit of believing this, and it often occurs, in analyzing our representations, that we find the cause that brings them out and connects them. If I hear a bell, and, without seeing it, conceive its roundish form, its clapper, and its dark-green color, the connection of ideas is understood to be natural, useful, and true; it is derived from previous experiences. It is a piece of the outer world registered in my mind. But these associations of colors with sounds are factitious, have a purely individual character, and correspond with nothing in the order of external facts. A sound is a sound, and has nothing in common with a color. The human voice is grave or sharp, and is not yellow or green. How has such an association been created and developed in the face of good sense? It is evident that the act of establishing tenacious associations between impressions that have nothing in common is the sign of some intellectual form which is not everybody's. We are disposed to attach some importance to the quality of the illusions evoked. They are of a visual character, which seems to indicate that there exists in colored audition an intense rush of visual images and a tendency to think as well as to feel with them; in short, we suppose that those who have colored audition belong to the category of visuals, or persons who, according to the classification of M. Charcot and many physiologists following him, have visual memories. As the case of M. Inaudi enabled us to study a high development of the auditive memory, another category in this classification, colored audition, will perhaps permit us to study visual memory. This is only a hypothesis; for it is not absolutely certain that colored audition always agrees with the type of visual memory, and that there is a causal relation between the two things, but we do not advance it without the support of good reasons.

First, we have the testimony of the subjects whom we have had opportunities to question. We addressing them in a tone of indifference and without trying to dictate their responses, they have remarked that colors and forms are the things they remember most easily. A young woman to whom I sent my requests in writing to avoid the unconscious suggestions of accent, answered me, "You ask me if I more easily recollect things seen or things heard; things seen. When I recollect a conversation, the gestures

and the attitudes of the participants recall to me what was said. Successive pictures present themselves before my eyes, and those pictures enable me to call back what I heard." That is a real visual type. In determining the type, it is necessary also to take account of the tastes of persons, their aptitudes, and their favorite occupations. Most of those whom I have seen, practice at painting or water colors, and some are painters by profession: others have been drawn by circumstances into different careers, but nearly all of them love color and Nature and have a passion for beautiful hues. Take notice also of their language. Whenever they describe their mental condition they have a marvelous abundance of picturesque expressions. Mr. Galton has justly remarked that few of those who have colored audition are satisfied with laconically naming the colors of the vowels; they must exactly define the shade, even if they are talking of white—a sensation so simple and apparently so easy to define without an epithet. They do not say, "*O* is white," but rather "*O* is a shade of white, the color of white plush, or of the under side of a fresh white mushroon." Another will say, "White mingled with milky and a little yellow"—or silver white, chalky white, etc. The use of these expressions informs us concerning the chromatic sense of these persons. They are colorists without doubt. We who have dull imaginations have the same words at our disposal as they, but we are unable to draw the same effects out of them. Words are like the colors we use in painting. Give two identical palettes to two painters, one of whom is a colorist like Delacroix and the other a draughtsman like Ingres; with the same colors one will produce a brilliant and the other a subdued picture. What permits us to give color to the canvas, as well as in the expression of our ideas, is, above everything else, the power of mental vision.

Our hypothesis is confirmed by some facts that have been brought out in M. Claparède's investigation of "visual schemes" or such figures as Mr. Galton has found some persons associating with their groupings of numbers, and which M. Claparède has found may be associated with other abstract conceptions, like the months and the days of the week. The results of his inquiry showed a frequent coincidence of colored audition with the faculty of forming such visual schemes. Without employing visual schemes, many persons represent the figures mentally to themselves as if they were written out—a method of representation which is another good characteristic of their type of memory. I have made an experiment on this point, instructive to me, which repeated upon a number of persons has always given concordant results. I pronounce five numbers to a person and ask him to repeat them; then six, and then seven, till the

number pronounced is more than the person can repeat exactly. I then ask him abruptly if he saw the numbers or heard them in his memory. Remark that this experiment appeals by its method wholly to the auditive memory. In nine cases out of ten, taking the subjects as they come, they will answer that they heard the numbers "in their ear," and had no idea of seeing them; or, if they saw them, it was by a confused, indirect mental vision. But those persons who have colored audition will answer that they saw the numbers. Although their auditive memory was excited by hearing, they transformed the auditive image of the number into a visual one; their attention was fixed on the form, the color—an excellent example of that tendency to transform everything into visions which seems to me to be the characteristic of colored audition.

This mental organization agrees in many of its characteristics, with that of the painter, the mark of whose vocation may be found, as M. Arréat has indicated in his La Psychologie du Peintre, in his sensitive-eye and his aptitude in appreciating, abstracting, and reproducing the brilliancy of colors and the harmony of forms, from which he acquires a habit of thinking with visual images. The natural gifts of the painter are, however, not all that is required for colored audition, but are only one of the psychological conditions of the phenomenon. A person capable of recollecting colors with their most delicate shadings might, by giving free course to his poetic imagination, color all the sounds that vibrate in his ear; but he would only arrive at intentional comparisons which he can make and unmake at will. The association in colored audition is very different; it is not sought for or selected; the subject does not invent it, he finds it already formed in his mind. He has only to hear a voice to have almost instantly the impression that that voice has a certain shade of color. Here we touch upon the fundamental characteristic of colored audition. Since it consists of an artificial and insurmountable association, it can not be regarded as a strictly physiological condition; it is a deviation, however insignificant we may suppose it to be, from the usual normal course of thought. Yet it generally coincides, according to the observations of the best authors, with a perfect state of physical and moral health, with perhaps a slight predominance of the nervous temperament in the majority of the subjects. The influence of heredity has been noticed several times. There have been as many as four or five cases in the same family, and considerable resemblance between the colored alphabets of relatives.

If the ultimate fundamental origin of colored audition is, as we beieve, in the organization of the individual, it remains to find the occasional cause that determines it and establishes a precise

connection between each kind of sound and a color. We should not suggest the problem if we thought it impossible to solve it by some direct method, and we have a firm hope that well-conducted personal investigations will at length discover the origin of the association. It may be that some importance may be attached to the picture reading books in which the letters are colored for the pleasure of children. Possibly, too, the consonance of certain words designating colored objects has been detached, by a kind of abstraction, from the word itself, and has carried the reflection of its color to other words in which it is found, although their meaning is entirely different. This second opinion is supported by an observation cited by Mr. Galton, of a lady who gave *e* the color of red, and believed it was because there is an *e* in the English word *red.*

We may summarize the knowledge we have concerning the mechanism of colored audition as follows: It is certain that the impressions of color suggested by certain acoustic sensations are mental images; it is probable that those persons who experience these impressions belong to a visual type; and it is possible that the bond between the impressions is the result of associated perceptions.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

## SOME CHARACTERISTICS OF NORTHWESTERN INDIANS.

THE Kootenay Indians, who number between five hundred and a thousand persons, inhabit a strip of country between the Rocky and the Selkirk Mountains, partly in the United States and partly in British Columbia. As a rule, their moral character and behavior are good, and they are honest, kind, and hospitable; but a few incidents cited by Dr. A. F. Chamberlain, in his report concerning them to the British Association, indicate that they are sometimes moody and easily offended, especially when their demands are refused. They have also a keen sense of the ludicrous, and laugh at the misfortunes that befall their fellows. A favorite Sunday amusement among the Lower Kootenays is horse-running. "All the horses are assembled in a large, open space near the camp, and the Indians form a large circle round them, and, provided with long whips, they drive the horses to and fro for an hour or so, laughing and yelling to their hearts' content. Even the little boys take part in this sport. They also take great delight in breaking stubborn horses, and the whole camp looks on until the young man has succeeded in controlling his animal, guying him unmercifully if he makes mistakes." Although no

picture-writing upon rocks has been attributed to them, they have marked artistic ability, and exhibit their skill in ornamentation upon articles of dress and the implements of the chase. Indians who had had no instruction in drawing from the whites, employed by Dr. Chamberlain to make a series of drawings, drafted very good maps of their country, and seemed to have well grasped the idea of their work. Some of them were also able to recognize with ease the various physical features prominent in the printed maps of the Kootenay district. Their drawings of weapons, implements, etc., were excellent, and those of one of them in particular would never be suspected of being the product of aboriginal genius. "Pictures of houses, railway trains, etc., have a certain conventionality that is characteristic of savage races. Several of the Indians were able to draw an excellent and easily recognizable picture of the little steamboat that plied up and down the Columbia River. In their drawings of human beings, especial stress is laid upon the distinguishing features, and any peculiarity or abnormity is brought out with full force. Thus, a Stony Indian woman has no nose, a Chinaman has an immense single braid of hair, a white man an enormous beard, a certain Indian a colossal nose, and the like."

They have fourteen distinct names for colors, and their horses may be white, black, half white and half black, roan, "buckskin," "blue," sorrel, or mouse-colored.

The social position of women is not greatly different from that among the other surrounding tribes. Girls may be married at fifteen and young men at twenty years of age. In the olden times the young Indian wishing to marry "went at night to the lodge where slept the object of his affections, and, quietly lifting up the blankets to make sure, lay down beside her. The girl's people soon found him there, and threats were made. The young man's father meanwhile inquired where his son was, and, on being told that he was in such-and-such a lodge, went thither with his friends and discovered the young people together. The girl then left and went with her husband to his own people. He was at liberty to send his wife back to her relatives within a year if she turned out to be bad or he was dissatisfied with her. When guilty of adultery she was punished by having one of her braids cut off by her husband." Descent seems to be traced through the mother.

Private property in land was unknown, the country belonging to the tribe collectively; and demands for money are still made by the Lower Kootenays from any stranger intruding upon their domain. The hunter had no absolute right in his game, and it was distributed among the camp in order that all might have food. Women could hold property as well as men. The horses

were the property of the grown-up male children, as well as of the father, and could be gambled away by any one of them. The lodge seems to have been secured to the widow and children on the death of the father. The women inherited the kettles and other utensils, besides their saddles, blankets, "parfleshes," etc. The horses, canoes, weapons, etc., went to the male children if they were of age. In early times the dead man's relatives would swoop down upon the lodge soon after his death and appropriate the property substantially at their will. If the dead man left no relatives, the "strong man" of the tribe took possession of his property.

The Kootenays paid a worship to the sun, and they believed in the existence of spirits in everything animate and inanimate; even little stones, bits of rag, shavings of wood, have their spirits. These spirits can go anywhere, through glass, wood, or any substance, as through air. The touch of them causes death and disease. At the death of Indians their spirits may enter into fishes, bears, trees, etc.; in fact, into anything animate or inanimate. When a man is alive his spirit may exist in the form of a tomtit, a jay, a bear, a flower, etc. The spirits of the dead can return and visit their friends. In olden times sacrifices appear to have been made to the spirits of the mountains and of the forests to secure success in hunting, and to appease them when they were angered. Their language is supposed to differ from the ordinary Kootenay. A great or strong man has many spirits. The spirits were supposed to come often at the prayer of the medicine men, in the form of birds or the like. A tree is pointed out in the Kootenay region, in northern Idaho, from which Indians have jumped off on two successive occasions, in obedience to the promise of the medicine men that they should be able to fly like birds if they did so. Certain death, of course, awaited them. The shamans treated the sick by pressure upon various parts of the body, by pinching, etc.; practiced bloodletting, and pretended to extract the cause of the malady by suction with the mouth.

In the astronomy of the Kootenays the moon is regarded as a man and the sun as a woman. There was no sun in the beginning, and, after the Indians had vainly endeavored to discover it, the coyote was successful in making it rise above the mountains. Another version makes the chicken hawk cause the sun to rise. The coyote, getting angry, shoots an arrow at the sun, but misses, sets the prairie on fire, and has to run for dear life. The moon is said to have been found by the chicken hawk. A legend about the man in the moon may be of European origin. The stars are mostly Indians, who from time to time have got up into the sky. The Great Bear was an Indian woman, who sometimes was very angry; and the stars in her tail are Indians whom she has seized.

The Milky Way is the dog's trail. The thunder is caused by a great bird that lives far up in the sky. The lightning is made by the shooting of its arrows. At first there were no clouds. The daughter of the coyote married the thunder, and her father gave the clouds for a blanket. The Kootenays believe that they came from the East; and one of their myths ascribes to them an origin from a hole in the ground east of the Rocky Mountains. Another account says they sprang from the hairs of the black bear, which fell on the ground after he came out of the belly of the great fish that had swallowed him. There were no women at first. By and by an Indian went up into the mountains, and from a spirit who lived there received the first Kootenay woman. The origin of horses is ascribed to a medicine man who made a stick into the shape of the animal and then threw it away, whereupon it became a horse. The belief prevails that the white men get their cattle from the sea. It is said that they go every year to the Pacific Ocean to receive the cattle which come out of the waters. Many of the animal myths remind one of Uncle Remus.

Some very interesting legends are related by Prof. George W. Dawson as communicated to him by Mr. J. W. Mackay, Indian agent at Kamloops, from the stock of the Shuswap Indians. Like most of the Indian people they have a culture or creation hero with supernatural attributes, who with them figures as a coyote or small wolf, and is named Skil-ap. In the old times the salmon could not ascend the Fraser River on account of a dam which two old witches had made at Hell-gate Cañon. He told the people he would go down the river and break the dam, so that the salmon could come up, and instructed them that he would make his approach known by a great smoke. He transformed himself into a smooth, flat piece of board, floated down to the dam, was picked up by the women, who undertook to use the board as a plate, emerged from it as a child, and was cared for by them, till one day when they were absent he put something on his head that made him invulnerable, and destroyed the dam, after which the salmon began to go up in great numbers. Then he followed the bank of the river, keeping abreast of the vanguard of the salmon, and making a great smoke by setting fire to the woods as he proceeded, so that the people knew that he was coming. Near the outlet of the Kamloops Lake he stopped to eat, and made a fish weir at a spot where some high rocks may still be seen. At the mouth of the Clearwater he completed a salmon dam he found the people making; and there are to the present day steep rocks on either side of the river, and above them a large pool or basin where he fished with his scoop-net and which is still a noted salmon-fishing place. On the rocks may be seen the prints of his feet where he stood to fish. Thus the salmon were

enabled to ascend into all the rivers of the Shuswap country. Skil-ap is expected to return at some distant period when "the world turns" and the good old days come back.

There were in the early times of Skil-ap other supernatural beings who roamed the world, the most important of whom was named Knil-i-elt; and it may be, Prof. Dawson suggests as a point worthy of inquiry, that in the stories related of Knil-i-elt and Skil-ap we find the mingling of mythological ideas derived from two different sources. Knil-i-elt had no recognized father or any relative but his mother, and was the offspring of the union of the woman with a root which is eaten by the Indians. Learning the mystery of his birth after he had become a great hunter, he reproached his mother concerning it, and said he would go away and never return to her. She then told him of all the evil and malignant monsters living in the country farther down the river, and he resolved to extirpate them. Among his exploits was a trial of strength with two friends, in which each should push his head against a rock and see which could make the deepest impression. Each of the friends made a shallow indentation, but Knil-i-elt pressed his head in to the shoulders. Impressions in the rock are still shown by the Indians, and Hat Creek, near the mouth of which they were made, was named from the incident. A conflict with the eagle monster resulted in the death of the eagle and the capture of its eaglets, pulling out the tail feathers from which, Knil-i-elt reduced them to common eagles, able to harm no man. At the outlet of Kamloops Lake was an elk monster that lived in the middle of the river and killed and ate men. Knil-i-elt, having made a raft, embarked and floated down the stream, when, before long, the elk seized and swallowed him. His friends, who were looking on, thought they had seen the last of him, but Knil-i-elt stabbed the elk to the heart with the weapon he carried, and then cut his way out of its belly and came to shore, bringing the elk with him, and invited his friends to eat some of the meat. He then reduced the elk to its present position, saying to it: "You will no longer kill men; they will in future always kill you." The badger was also in this early time a formidable monster, and had its lodge stored with dead men, collected for food. Knil-i-elt caught the badger, and striking him on the head said, "Hereafter you will be nothing but a common badger, able only to fight with dogs when they attack you." He further brought to life again all the people whom he found dead. Knil-i-elt met his fate from four witches, whose supernatural power was superior to his, and who turned him and the two friends who had accompanied him in all his adventures into stone.

On the trail leading from Kamloops toward Trout Lake the scanty remnant of an old stump protrudes from among a few

stones which are piled about it, in passing which the Indians always throw some little offering upon it—such as matches, a fragment of tobacco, or a shred of clothing, which were seen by the author. The story attached to it relates that a lonely woman called Grizzly Bear made of pitch the figure of a girl to be a companion to her, who became her daughter. She warned the girl that when she bathed she must not afterward sit or lie in the sun to get warm. The girl tried the forbidden experiment after her fourth bath, and was melted away. Grizzly made another daughter of clay, and told her that she must not rub herself when in the water. This girl disobeyed likewise and was washed away. The old woman than made another daughter of wood, on whom it was not necessary to impose restrictions. This girl, after a fourth bath, was accosted by a trout, which she said she would like for a husband. On repeating her wish the fourth time the trout appeared as a young man, became her husband, and took her with four efforts, the first three of which were balked, to his lower country. A boy and a girl were born to this couple. They were taunted about having no grandmother, and, questioning their mother on the subject, were told that they had a grandmother living in the upper country. They might go up there and would find her as an old woman digging roots on the hillside, but must not speak to her, though they might go to her house and eat whatever food they might find there. The children acting upon these instructions, the woman missed the food, and, observing the footprints of the children, concluded that none but her daughter's children would visit her house in that way. She therefore prepared some potent medicine, and, going to a stump in the hillside where she was accustomed to work, told it that when the children appeared it must move and seem to be a woman digging. The woman then concealed herself in the house, while the stump acted as it had been bidden. The children, after regarding the stump for a time with some doubt, ventured into the house, when the woman threw her medicine upon them. The medicine fell all over the boy, who was changed to an ordinary human being, but only partly over the girl, and she became a little dog. The boy and the dog, in whom he failed to recognize his sister, had some curious adventures, in the course of which he learned the truth. He went to his grandmother and questioned her on the subject. She told him that if, when shooting, his arrow should lodge in a tree, or anywhere above his reach, however little, he must not climb up to get it. Soon afterward he lost three arrows in this way, but a fourth time his arrow stuck in a tree not far up, and he climbed on a branch to get it; but the arrow continued to move further up and he had to climb after it, and though he thought that he had not gone very far, he looked

down after a time and found that he could not even see the earth. So he went on climbing till at last he reached another country above, which was very pleasant and populous, and there he remained. The old stump by the wayside is the remnant of that tree.

Another curious story relates to a mosquito gorged with blood, which flew up where the thunder is. The thunder asked the mosquito where it got the blood, and the insect falsely replied that it was sucked from the buds at the very top of the trees below. Hence the reason that the thunder (or lightning) strikes the tops of the trees.

Some curious myths are associated with particular places. The lakes are supposed to be occupied by peculiar beings called "water people," who are alleged to have remarkable powers and to use them in performing strange acts. It is dangerous for canoes to pass Battle Bluff, on Kamloops Lake, because of the water people, who in this instance are described as of human shape, but hairy in the upper half, with fishlike tails below. It is also told of this bluff that some hostile people, once coming by land to attack the Kamloops Indians, looking down over the front of the bluff as they passed, saw a woman or witch dancing in a niche part way down the cliff. They sat down on the edge of the cliff to watch the woman dance and were turned to stones. "Little men" are reported to exist in several places, to hunt with bows and arrows, to be only two feet high, and yet able to carry a deer easily. In contrast to this, when a squirrel is killed, they skin it and take only a part, as the whole is too heavy for them. The Indians are very much afraid of them. The Indians aver that unknown beings sometimes throw stones at them, particularly at night, when stones may be noticed occasionally falling into the fire. A Kamloops Indian, long since dead, once saw a white object following him by night. He drew back from the trail and shot an arrow at it as it passed. In the morning he returned and found his arrow buried in a human shoulder-blade. It is believed that burning wood from a tree which had been struck by lightning brings on cold weather. This appears to be based on the fact that cold follows a thunderstorm. Thus, in the spring, when Indians may be traveling over the snow on high ground, splinters of such wood are thrown on the fire to reduce the temperature, in order that the crust may remain unmelted on the snow. A small splinter of such wood wrapped up with the bullet in loading a gun is supposed to increase the deadly effect of the bullet. The plant *Parnassia fimbriata*, worn in the hat or rubbed on it and on the soles of the feet, is believed to make it certain for the deer-hunter that the deer will be seen and caught. The rattle of a rattlesnake is worn as a preventive against headache.

The Pleiades are called by the Shuswaps "the bunch," and also "people roasting." The latter name is given from a story of their origin, which relates that a number of women who were baking roots in a hole in the ground were changed into this group of stars. The morning star has the names "coming with the daylight" and "one with hair standing out round his head." The four stars forming the bowl of the Great Dipper are known as the bear stars, and the three following large stars are three brothers in pursuit of the bear. The first hunter is brave and near the bear; the second leads a dog (the small companion star); and the third is afraid and hangs far back. The stars of Orion's belt are called "fishing," and the Milky Way is the road or path of the dead. The months, beginning about March, are "spring," "grass month," "root-digging month," "strawberry month," "berry month," "salmon month," "month when the salmon get bad," "month when the deer travel," "month in which they return from hunting," "midwinter month," and *Pit-tshik-in-tin*" (which is not translated).

Several native roots still constitute notable items in the food of the Shuswaps, though their importance has diminished since the white man's preparations were introduced. Roots are always dug and cooked or cured by the women. In digging the roots a pointed stick, about four feet in length, with a crutch-shaped handle, is used. The lily, *Lilium columbianum*, is much sought after, and, like most of the roots, is cooked by baking in the ground. The roots of balsamorhiza, cinquefoil, claytonia or spring beauty, dog-tooth violet, and of other less familiar plants, are also eaten. The camass is abundant, and forms an important article of diet. No edible thing is ignored, and few edible substances of any kind are passed by; but the Indians never heard of any one eating a mushroom. The cambium layer of the black or bull pine (*Pinus murrayana*) is eaten when it is soft and gelatinous, at the time the leaves are still growing, and is sometimes dried and kept. The cambium of the subalpine spruce and of cottonwood is also sometimes eaten. The sappy and still nearly white parts of the large leaf-stalks and stems of the *Heracleum lanatum* are eaten in the spring, and, when taken at the right stage, are not much inferior to celery. The nutlets in the cones of *Pinus albicantes* are gathered in large quantities and eaten from the cones after having been roasted, or thrashed out and prepared. They have a rather pleasant taste, flavored with turpentine, and are nearly the size of small garden peas. Nutlets of yellow pine and Douglas fir are also collected—generally by robbing the mice and squirrels of their stores. The pith or inner bark of *Epilobium spicatum* is eaten while still young and sappy. A black, hairlike lichen, *Alectoria jubata*, is eaten roasted, and is

said to taste very sweet. A yellow lichen furnishes a coloring matter, and the root of a certain fern (*Asplenium* or *Aspidium*) yields a black dye. The leaves of the syringa (*Philadelphus lewisii*) were formerly used as a soap in washing clothing. The fiber plants are an *Asclepias* or milkweed, and the common nettle of the country.

The sweat-houses of all the Northwestern Indians are very much alike. They consist of a dome-shaped framework, formed by bending willow sticks over one another, covered with blankets or skins or earth, and a pile of hot stones in the center, or a hole in which hot stones are thrown. The Indian takes his place in the booth, and water is thrown upon the stones. The bathers sit in a suffocating temperature till they have had enough of it, and then rush out and plunge into the water, which they take care to have always near.

## SKETCH OF WERNER VON SIEMENS.

WITH Werner Siemens, says a German biographer, died a prince of science, a pathbreaker in the region of electrotechnics, a man whose activity extended far beyond his own narrow district, bearing fruit in other branches of human achievement; one of the greatest industrial characters, not of Germany only, but of the whole world; an industrial character, however, to whom gain was never an object in itself, but who rather found in it the incentive to new scientific studies.

Ernst Werner Siemens was born at Lenthe, Hanover, December 13, 1816, and died in Berlin, December 6, 1892. He came of a family very rich in offspring—while he was the eldest son among ten children. His father, Christian Ferdinand Siemens, was a tenant farmer and forester, who had qualified himself for his profession by studying at the school at Ilfeld and the University of Göttingen. He afterward went to learn practical agriculture with Councilor Deichmann at Poggenhagen, where he married the councilor's daughter, Eleanora Deichmann, preparatory to settling upon his estate at Lenthe.

The English think they have a kind of birthright claim upon Werner Siemens, because, at the time of his birth, the King of England was Elector of Hanover. The connection is not entirely flattering to them, for the elder Siemens fared hardly at the hands of King George. He was arrested and fined for detaining some royal deer which had trespassed upon his premises while awaiting the answer of the gamekeeper to his inquiry as to the disposition he should make of them. To escape such unpleasant incidents the elder Siemens removed, in 1823, to Menzendorf in

Mecklenburg-Strelitz. Werner Siemens's earliest recollection of his life at Lenthe was of what in his Reminiscences he calls an act of heroism. When he was about five years old his sister came crying into his father's room where he was playing. She had been sent to the Pfarhaus to take her lesson, but found her way obstructed at the gate by a gander, which snapped at her whenever she attempted to pass. The father gave Werner his staff and told him to go with his sister and to cudgel the gander well when it appeared. The boy did so, and the gander ran away in panic. "It is remarkable," he says, "how deep and enduring an impression this first victory made on my childish mind. Even now, after nearly seventy years, all the persons and scenes connected with this important event stand clearly before my eyes. With it is also associated my only recollection of the appearance of my parents in their younger days; and many a time, in later difficult experiences, has the victory over the gander unconsciously incited me not to shun threatening dangers but to meet them with vigorous resistance."

The Siemens children were taught by their grandmother Deichmann, and then by their father, whose brilliant and original sketches of history and ethnology, dictated to them, formed the foundation, Siemens says, of his later views. He was next sent to the *Bürgerschule*, in the neighboring town of Schönberg, whither he walked when the roads were not too bad, and where he seems to have spent a year of battling with his mates, "to the hardening of his powers, but with only the most insignificant results in knowledge." Then he had tutors of opposite characters, and after them he was sent to the gymnasium at Lübeck. Not satisfied with the progress he was making in mathematics and in the ancient languages, he gave his attention to the only technical branch taught in the school—engineering. To prepare for entrance into the engineering school at Berlin, he took private lessons in mathematics and surveying. Instead of entering this school, which was expensive, his teacher advised him to go into the Prussian engineering service, where he would be taught the same things. His father fell in with this plan, and prophetically gave as his reason that the present conditions could not last in Germany, that in time everything must go down. The only firm point in Germany was the state of Frederick the Great, with the Prussian army; and in the time of trouble that was coming it would be better to be the hammer than the anvil. Fortune favored him in the examinations, for which his preparation had been very superficial, and in the fall of 1835 he was admitted to the United Artillery and Engineers' School in Berlin. His mother dying in July, 1839, and his father six months later, he became the guardian of his younger brothers and sisters. Some

experiments he was making at this time with friction fuses ended in an explosion, by which his hearing was permanently injured.

While Siemens was stationed, in 1840, at Wittenberg, he became interested in the discovery, then recently made by Jacobi, of the precipitation of metallic copper from the sulphate by means of the galvanic current. He repeated the experiments successfully, and applied the process—so far as his means would permit—to other metals. His studies were interrupted by his arrest and imprisonment for connection as second with a duel between two of his brother-officers. Not relishing the idea of spending an indefinite period in idleness, he managed on his way to the citadel to make arrangements to have the materials required in his electroplating researches smuggled in to him. He set up a small laboratory in his cell and made himself contented there. Recollecting, from experiments he had made in the Daguerrean process, that hyposulphite of soda would dissolve the insoluble salts of gold and silver, he applied the principle to electrolysis with astonishing success; and he believes, he says, that it was one of the greatest joys of his life when a newly silvered teaspoon which he had immersed at the zinc pole of a Daniell cell into a cup filled with a hyposulphite gold solution, while the copper pole was connected with a louis d'or as an anode, "was converted in a few minutes into a gilded spoon of the most beautiful, purest golden luster." Galvano-plating was then new in Germany, and his discovery made much talk. A jeweler of Magdeburg, visiting him in prison to examine into its merits, he sold him the right to use it for forty louis, and thus obtained means for continuing his experiments. He counted upon enjoying still several months of captivity, and the unmolested prosecution of his researches, when the unwelcome message came to him of a royal pardon, and he was obliged to leave the citadel at once, without house or other spot in which to set up his apparatus. He asked leave from the commandant to stay a little longer, but was denied, accused of being ungrateful for the royal clemency, and was hurried out of his quarters at midnight. He had gained by his experimenting the reputation of not being well qualified for practical work, and was assigned to the fireworks factory at Spandau. He had great success in making pieces of unexampled brilliancy for the birthday celebration of the Emperor of Russia, and was invited to compete in a sailboat race with Prince Frederick Karl—and beat him. Then he was ordered to Berlin, to serve in the artillery arsenal; to his great delight—for this commission would give him time and opportunity for carrying on his researches.

Wilhelm Siemens having completed his studies and constructed a steam engine, Werner furnished it with a differential regulator. He made a profitable contract with a silver-ware

house in Berlin for the use of his plating apparatus, and Wilhelm was dispatched to England to introduce the inventions there. Besides the galvano-plating patent, which was sold to Elkington & Co. for £1,500, there were processes for nickel-plating and for anastatic printing, etc. A journey to London to assist Wilhelm in some financial difficulty, in which he visited Paris and Brussels on his return, gave him new and higher views of his work, while its results satisfied him that the road to wealth did not lie through speculation in inventions. He entered upon a more thorough course of study, formed associations with the young naturalists of the time, some of whom have since become famous, joined in the foundation of the Physical Society, interested himself in the Polytechnic Society, and sought to promote the technical applications of science. He became acquainted with manufacturers, and published articles in the scientific journals on "The Application of Hot Air as a Motive Power," in which he accepted Mayer's and Helmholtz's doctrine of the conservation of force; describing his differential regulator; and "On the Application of the Electric Spark to the Measurement of Velocity."

Werner Siemens became warmly interested in the experiments which Leonhardt was making, at the instance of the general staff of the army, in the substitution of an electrical apparatus for optical telegraphy. He had seen a model of Wheatstone's telegraph in the house of one of his comrades, and had tried to establish a communication between the house and a mineral-water establishment across the garden. He devised an improvement in the apparatus for generating and controlling the current, which attracted the attention of the mechanician Halske, who eventually gave up his business and associated himself with Siemens in telegraphy.

Siemens's plans were again embarrassed by the results of his and his companions' inconsiderately signing a paper connected with the religious movement of John Ronge, which was considered seditious. His brigade, to punish the offenders, was ordered to a retired post. It was important for him to remain in Berlin to prosecute his researches, and he devised a means to induce the Government to keep him there. Schönbein had made his first discovery of gun-cotton, but the material he produced was poor and unreliable. Siemens spent a day in experimenting upon it; added treatment with sulphuric acid, and obtained a certain and really practicable explosive. He communicated his discovery to the Minister of War, and was ordered to continue his experiments at the Spandau Arsenal, while his punishment was forgotten. Unfortunately, Prof. Otto, of Brunswick, who had independently discovered the same method, anticipated him in publication, and thus deprived him of the credit of priority.

Having communicated with General Oetzel, the chief of the military telegraphic service, he was invited to assist in the substitution of electric for optical telegraphs. He gained the confidence of the general and of his son-in-law, Prof. Dove, and was commissioned to carry out his own plans. The lines were to be put underground, and there was difficulty about finding satisfactory insulating material. Wilhelm Siemens had sent him some specimens of gutta percha from London as a curiosity. It was found eminently adapted to the purpose of an insulator. With a press supplied by Halske, the wires were successfully covered, and the lines were established with Siemens's instruments. In October, 1847, the firm of Siemens and Halske was formed, which, beginning in a rear building with a modest capital, was destined to ramify till it had branches in several of the capitals of Europe, and became prominent in the construction of Continental telegraphs and the world's cable lines.

The revolutionary movements of 1848 brought the extension of telegraphic enterprises to a temporary halt. The Siemens-Halske establishment, nevertheless, went on with its work, though it had no orders. In a short time Siemens was commissioned to lay submarine electric batteries in the harbor of Kiel for protection against an apprehended attack by Danish vessels. Having assured the perfect working of his mines from the shore, he collected a band of volunteers in the city and surprised the post of Friedrichsort, at the entrance to the harbor, under the protection of which, it being held by the Danes, the Danish fleet might have approached alarmingly near to Kiel without being molested. As commandant of Friedrichsort, he built the fortifications for the protection of the harbor of Eckernförde, which became very famous the next year in connection with the rout of the Danish squadron.

Siemens was next commissioned to lay an underground telegraph from Berlin to Frankfort-on-the-Main where the German National Assembly met. The transmission of the result of an election in the winter of 1879 to Berlin, within the hour, gave the line great repute, and Siemens was employed to construct another line from Berlin to Cologne and Verviers, on the Prussian frontier. In this enterprise he had the assistance of William Meyer, a man skilled in organization. Many difficulties incident to the imperfections of an art still in a crude condition are described as having been encountered in executing these works. The constructors were sorely embarrassed, in crossing the Elbe and the Rhine, to find means for protecting the wires against dragging by ships' anchors. The wire across the Rhine was inclosed in a wrought-iron tube so well that, when it was taken up several years afterward, a number of anchors were found hanging from

it which, having been caught in it, the shipmasters had been obliged to cast away. At Verviers the line was connected with an overhead line to Brussels. One Herr Reuter, who had been managing a carrier-pigeon post between Cologne and Brussels, found his business ruined by the telegraph. Frau Reuter complaining to Siemens of this, he advised the pair to go to London and establish there a telegraphic news agency, as Herr Wolff had succeeded in doing at Berlin. This was the origin of "Reuter's." These enterprises had been carried on under a furlough from army service, which was about to expire, and Herr Siemens, in order to devote himself to scientific and technical work, resigned his position in the army in June, 1849, left the telegraphic service shortly afterward, and began a career of independent scientific industry. His underground system was generally adopted in Germany. To prevent the depredations of rats on the gutta-percha coatings, he drew the wire through lead pipes. He recognized the excellences of the Morse telegraphic instrument, and sought to improve it. In April, 1850, he presented a memoir on his experiments in telegraphy—*Mémoire sur la Télégraphie Électrique*—before the French Academy of Sciences, and received, upon the report of the committee to which it was referred, the acknowledgment of the Academy, thus fixing the stamp of that authority upon his claims for originality and priority.

While Siemens's system was being extended and adopted in foreign countries, particularly in Russia, the Prussian lines, under official management, constructed in a slovenly manner and carelessly repaired, deteriorated. Siemens published a pamphlet criticising these faults and pointing out the remedies, in consequence of which unauthorized comment the Government discontinued all connection with his house for several years. The loss of this business was, however, more than compensated for by that which accrued from railroad telegraphy, still free from official domination, and by contracts coming in from abroad.

The connection of Siemens with the Russian telegraph lines began in 1849, when his instruments were adopted for the line between St. Petersburg and Moscow. In the winter of 1852 he went to Riga, on business connected with the construction of a line to that point, and particularly with the crossing of the Dwina. Other lines calling for visits to Russia, and in connection with which the St. Petersburg branch of the house of Siemens and Halske was built up, were those to Kronstadt—the first successful submarine cable line—and Warsaw. The success of the last line determined the Russian Government to cover the whole empire with a telegraphic network, and lines were built in succession from Moscow to Kiev, Kiev to Odessa, St. Petersburg to Revel, from Kovno to the Prussian borders, and from St. Peters-

burg to Helsingfors. Then the Crimean War came on, and the firm was kept busy with the special lines demanded for its prosecution.

After two failures by an English firm in trying to lay a telegraphic cable between the island of Sardinia and Bona in Algeria, the third attempt was successfully carried out in September, 1857, with material furnished by Herr Siemens's house and in a method prescribed by him. This was the first of the deep-sea cables, or of those which were laid in water more than one thousand fathoms deep, and was followed by the laying of many longer lines, in most of which enterprises Herr Siemens had a part. In 1859 he was shipwrecked on the Alma in the Red Sea; in 1863 he came very near losing his life while trying, with his brother Wilhelm, to lay the cable between Oran and Cartagena. The brothers laid the line from Malta to Alexandria, and, with the steamer Faraday, built especially for the purpose, they laid six transatlantic lines. In its attempts to maintain telegraphic communication with India the British Government had found its lines through the Mediterranean Sea, Asia Minor, and Persia too liable to interruption to be depended upon. To take the lines through safer regions they would have to be carried partly through Russian territory. Herr Siemens was applied to, and he, through the good will he had won by his constructions for the Russian Government, secured a concession from it for building a line through Kiev, Odessa, Kertch, and the Black Sea to Suchum Kale. The business of this line led him several times into the country of the Caucasus, concerning which and the prehistoric copper mines at Kedabeg and the German colony at Annenfeld in the same region he gives, in his Reminiscences, some very pleasant accounts.

As much as to his improvements in the electric telegraph, the practical applications of electricity owe to Siemens's invention of the dynamo-electric machine in the winter of 1866, which opened to them entirely new fields in the development of power and light. In claiming the credit due to himself in this field, he does not forget to acknowledge what he owes to the predecessors who laid the foundations on which he built.

While thus busy with the development and practical application of electrotechnics, as he called it, Siemens observed and participated in the advancement of other branches of science; and we find him now busy in investigating the geological structure of the earth; now engaged, with his brother Wilhelm, in researches concerning the cause of the sun's heat and the means by which it is maintained, or studying with his brother Friedrich new problems of heat; now plunged in the most abstruse problems of meteorology; now sharply criticising the bacillus theories of Dr.

Koch—all with the knowledge and consideration of one who had made deep studies of the subjects.

Dr. Siemens's literary efforts were limited, he tells us, chiefly to expositions of his scientific and technical labors and descriptions of his mechanical constructions. He had sometimes occasion to answer attacks upon his firm or upon himself personally. Besides those of which we have already spoken, he mentions as among his principal contributions to scientific literature a paper in Poggendorff's Annals, in 1857, on Electrostatic Induction and the Retardation of the Current in Conducting Wires; a communication made conjointly with his brother Wilhelm to the British Association in 1860 (Sketch of the Principles and of Practical Experience in the Testing of Submarine Telegraph Lines and their Conductivity); his lecture, in 1879, on Electricity in the Service of Life; and his address before the Society of German Naturalists and Physicians, in 1886, on The Scientific Age; papers On the Light of a Flame; On the Admissibility of the Conception of an Electric Sun-potential and its Significance in Explanation of Terrestrial Phenomena (called out by the discussion of his brother Wilhelm's paper, On the Conservation of the Solar Energy); Contributions to the Theory of Electromagnetism; On the Maintenance of Force in the Atmosphere of the Earth, 1881 and 1884; On the Question of Air Currents, 1887; On the General Wind System of the Earth, 1890; and On the Question of the Cause of Atmospheric Currents, 1891.

He elaborated the plans, and saw them adopted by the Prussian Government and Parliament, of the Physical-technical Imperial Institute at Charlottenburg for scientific research, of which Helmholtz is director. In 1874 he was made a member of the Royal Academy of Sciences of Berlin. He received the degree of Doctor of Philosophy, *honoris causa*, from the University of Berlin; was made a Knight of the Prussian Order for Merit; and received the patent of nobility in 1888. He was also a member of many learned societies.

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M. J. Dybowski has transmitted to the French Academy of Sciences specimens of a condiment prepared by the peoples living on the banks of the Oubangui River, one of the affluents of the Congo. It is obtained by the incineration of river plants, and is composed chiefly of chloride and sulphate of potassium, with very little carbonate of potassium and no soda. This confirms former observations of the scarcity of soda in land plants. These usually contain considerable quantities of a very alkaline carbonate of potassium, not suitable as a condiment. The natives choose for incineration certain species containing only slight proportions of the carbonate. Although the salts of potash are considered unwholesome, these natives do not appear to suffer from using them.

# EDITOR'S TABLE.

### *AIDS TO MISERY.*

AN extremely instructive article appears in the Fortnightly Review for August, under the title of The Poor of the World. The author, Mr. Samuel A. Barnett, has been traveling round the world in order to inform himself by personal observation and inquiry as to the condition of the poor in different countries. The result, so far as presented in this article, is to show that everywhere the great underlying cause of poverty is lack of individuality and the power of self-help, and that the only ultimate remedy is the creation through education—understanding the word in its widest sense—of more perfect individuals. This is the doctrine which Mr. Spencer has been preaching directly and indirectly for many years past, often at the cost of much contumely and, in general, to unbelieving ears. The reason for the unpopularity of this view is not far to seek. Eager reformers do not like to think that the evils they combat are deep-seated and can only be slowly worked out of human nature; they cherish the hope of accomplishing great things in a short time and seeing the fruit of their labors in a striking form. Sentimental persons, again, always want to cast the blame of what is wrong on somebody; and if they can not see quite clearly who in particular is to blame, they denounce "society." It is pleasanter to feel ourselves fighting the selfish, the indifferent, the grasping, or those whom we are pleased to consider such, than to accept the position of simply trying to repair evils inherent in the condition of things as molded by natural forces. All within us that craves for the quick, the short, the easy, the sensational, indisposes us to accept a theory that opens up a vista of patient, prolonged, and carefully revised effort, bringing with it little of glory at any one time, and calling for the exercise of no small amount of scientific faith.

We have been hearing lately of the sanguinary conflicts of Hindus and Mohammedans in the streets of Bombay. Different as the creeds may be which the two races possess, Mr. Barnett found that the temples of the one and the mosques of the other were equally centers of distribution of a large amount of charity, the product of gifts gathered from the rich, and that the effects of this charity were most pernicious. "If ever," he says, "one is inclined to doubt the danger of priestcraft, a visit to India ought to dispel such doubts. He will find in the Brahmans a typical priesthood, and he will see how their unquestioned rule has degraded the people, until they seem without power of clear thinking or wide feeling." How charity serves the priesthood a double turn is well explained: "The pious give, not because their brothers have need, but to please the god; and it is nothing to them if their gifts are consumed by the priests or wasted on worthless objects. The priests give as priests—either to attract worshipers to their temple or to deliver their own souls." The charity thus dispensed, far from abating poverty increases and extends it. In Hyderabad, where the Mohammedans are in the ascendant, ten per cent of the revenue, in addition to large private gifts, is spent on keeping armies of beggars who are descendants of orthodox families, while it is quite a common thing for wills to provide for the feeding of idle multitudes on certain holy days of the year. In India, moreover, an obligation is laid upon all the members of a family to support one another. As a consequence, "the hard-

working and successful man is kept low by weak and very often idle relatives." The system, to quote Mr. Barnett again, "checks enterprise and tends to make a dead level of poverty in which there are no richer people to act as barriers against the flood of famine or bad times." One is sometimes touched, he confesses, by the way in which the strong hold on to the weak, but it is impossible not to notice that idlers abound. Nowhere is there so little individuality, nowhere such feebleness in prospect or in presence of calamity.

While family feeling is strong in India, the general feeling of humanity is weak. The reason, our author says, is "partly because the people think too much of their gods. . . . The chief duty of man seems to be to please his god; and when, by a gift, he has delivered himself of this duty, he thinks no more of his brother at the gate." Among such people the task of a government seeking to effect reforms becomes extremely difficult. "All measures," Mr. Barnett well observes, "must be ineffectual so long as the people themselves are deficient in life-preserving qualities, such as confidence, enterprise, and self-control." Here we have the gist of the whole matter. There are certain qualities, moral, intellectual, physical, which are *life-preserving*. They may be said to qualify for life; and when they are absent nothing but a constant strain upon better qualified individuals will enable the defective ones to survive. By "confidence," Mr. Barnett means in this place confidence in others, and he illustrates his remark by stating that, for want of confidence, any savings the poor can make in India "are not invested or even intrusted to a bank; they are turned into jewelry to burden the women's fingers, toes, noses, and ears, and at last sold to provide a marriage feast." He cites the fact that there are in India four hundred thousand jewelers and only three hundred thousand smiths. As a life-preserving quality, however, confidence in self is at least as important as confidence in others; and confidence in self, or, in other words, self-reliance, is just the quality at which so much of the charity of our day strikes. Charity is flowing in an ever-broadening stream; but it does not qualify for life those whom it enables to live; on the contrary, it saps what little energy they have, and so hands on a magnified problem to be dealt with by the charity of the future.

The inhabitants of India are said to be the most docile people in the world, but on that very account they are more difficult to govern, because their weakness makes them look to the Government for everything. As Mr. Barnett forcibly remarks, "It is perhaps more difficult to keep a weak man on his feet than to prevent a strong man from rising." If you have the strong man down you have gravitation in your favor; but in trying to keep the weak man up you have gravitation against you, and gravitation is apt to win in the long run. The Government of India, Mr. Barnett testifies, is doing a great deal of useful work in the promotion of industries, the improvement of the soil by irrigation, and the enforcement, as far as possible with such a population, of sanitary measures. But all this costs money, and as one thing leads to another, one abuse corrected revealing a dozen others that need correction, the expense of government and the burdens which the people have to bear in the way of taxation are constantly increasing. "Government," as Mr. Barnett puts it, "does much to relieve the people, but the conclusion of the whole matter leaves one doubtful if it would not be more helpful if it did less for them and took less from them." And he pithily adds, "A system undoubtedly good may be so costly as to be bad." Surely there is much in all this that we may reflect on with advantage here. The advantage of such a comparative study as Mr. Barnett is making is that it shows various evils in their fuller development, and puts com-

munities in which they may exist only in lesser degree on their guard.

Mr. Barnett has also made a few observations in this country. He found in San Francisco a form of government "so democratic as to leave hardly a grievance for the most ardent demagogue." And yet "the poor increase, and the talk is as the talk of East London about starvation cases and the inadequacy of the poorhouse; the demand is for laws to prevent vagrancy, to reduce rents and limit immigration." There is abundant charity; the officer of the Associated Charities, we are told, "confessed that it was impossible to control the impulses of the rich men of the city; and if he complained that gifts did mischief, the answer was, 'What is that to me?'"

In Boston there is a very perfect system for the organization of charity; but when Mr. Barnett inquired whether the clergy and philanthropic persons made use of the records kept in the central office, the answer was, "No." Here, as elsewhere, "private charity is wayward and willful; gifts go as passing emotion directs, institutions are created which represent the fancy rather than the sympathy of the creators." Then, when gifts are found to be of no avail, repressive legislation is resorted to—laws against drinking and even cigarette-smoking. The drink must be taken in a perpendicular position, and the cigarette must not be smoked by any person under a certain age. Mr. Barnett's article is good reading, and as a capital appendix to it we recommend the chapters on Negative and Positive Beneficence Mr. Spencer's last volume. The philosopher is justified by every wide and impartial survey of the facts.

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### *THE AMERICAN ASSOCIATION MEETING AT MADISON.*

Experience shows the American Association that it can have a large attendance at its meetings only by keeping to the main highways of travel, and by choosing large cities. With the World's Fair as a magnet, drawing and holding hundreds of its members, the association was fortunate in assembling as many as it did, some two hundred and ninety, at Madison. Those who attended were rewarded by good papers and stimulating discussions, and if the sectional meetings were smaller than usual, they were uncommonly earnest and interesting from the absence of the distractions not to be avoided when a multitude gathers together. Hospitality was hearty; the people of Madison—a city, by the way, of singular beauty—with the University of Wisconsin, renewed the best traditions of the Association in manifold opportunities for bringing old friends together, for presenting beginners in science to leaders grown gray in the service of truth.

In his opening remarks President William Harkness, of Washington, touched on a practice of the Academy of Sciences of France well worthy of imitation in America—the conferring membership upon those of its friends who, while not themselves men of science, provide financial aid for research. At Nice, for example, an observatory of world-wide repute has arisen as a gift of Mr. Bischoffsheim, a banker, whose name is rightfully enrolled beside those of the astronomers whose labors he has lightened and promoted.

Evolution was the keynote in the addresses of the vice-presidents in the Sections of Zoölogy, Botany, and Economics. Prof. H. F. Osborn, in sketching the Ascent of the Mammalia, traced the succession of typical species plainly derived one from another. Exploration within recent years, he said, has but served to confirm Prof. O. C. Marsh's demonstration of the horse's genealogy through forms with which Prof. Huxley in his American lectures has made the world familiar.

Prof. Charles E. Bessey, in his address on Evolution and Classification,

said that for nearly forty years the system of Linnæus stood in the way of the better system of Jussieu and De Candolle; that system in its turn has for a third of a century been a clog and a hindrance to the adoption of the vivifying idea that genetic ties are the true basis for classification. The botanist in giving this new and illuminating order to plants must be careful to discriminate between primitively simple forms and those simple by derivation. Parasites are far from being the only plants that have undergone simplification of structure; in willows and poplars, for example, a single ovary has resulted from the union of two or three ovaries. For flowering plants Prof. Bessey presented in detail a revised arrangement of the Benthamian series.

The Mutual Relations of Science and Stock-breeding gave Prof. W. H. Brewer, in his address to the Economic Section, an opportunity of showing how an art is broadened and bettered when it flowers into a science. Until Darwin's Origin of Species was published stock-breeding followed the rule of thumb, with results slow and uncertain; to-day, when heredity is understood as due to influences largely calculable and controllable, stock-breeding almost rises to the assuredness of a plastic art. Prof. Brewer spoke of a sheep-breeder of his acquaintance who has all the ideality of the true artist, who figures to himself a perfect sheep with every good point at its best, every defect eliminated; in striving to give substance to that form as he imagines it, this man is as devoted as any wielder of chisel or brush. Breeding, said Prof. Brewer, can alone decide whether acquired characteristics are transmitted, and it may even throw an important side light on vexed questions of education.

Prof. E. L. Nichols, in his address to the physicists on Phenomena of the Time Infinitesimal, showed a bullet in flight photographed in an interval so brief that the missile seemed at rest. In another picture the bullet was shown in the act of shattering a pane of glass, with all the incidental perturbation of the surrounding air. In giving rapid motion to the sensitive plate Prof. Nichols pointed out how its availability can be vastly extended. In this field, he maintained, there is abundant harvest for the investigator, for when the time interval is appreciable we do not get a picture really instantaneous, but only a composite photograph whose elements we have to guess at. As to what happens in the first hundredths of a second in the polarization of the voltaic cell, in electrolysis, nothing is known, and here possibilities of the highest interest await the suitable application of the camera.

In reviewing twenty-five years' progress in analytical chemistry Prof. Edward Hart brought out its remarkable stimulus from the exigencies of industry, and the no less remarkable fashion in which the debt had been repaid. In 1868 the determination of phosphorus in steel required two to three days; to-day twelve minutes suffice. At the furnaces of South Bethlehem, Pa., a sample of molten metal is passed upon by the analyst while the iron is still on its way to the converter; the manufacture can thus be intelligently directed with the utmost promptness. This is but one of the important ways in which the chemist has borne a part in cheapening iron and steel. The work of analysis, in this and other departments, has been greatly quickened by developing those methods which allow the chemist to determine in a single specimen one constituent rapidly and accurately. It is preferable to determine phosphorus in one sample and sulphur in another than to determine each separately in the same sample. In closing his review Prof. Hart mentioned the honored chemists of America who have notably contributed to the world's advance in their science during the past quarter of a century—men little known to a nation richer, longer lived, and happier because of their

unselfish labor. Prof. S. W. Robinson, addressing the Mechanical Section on the education of the engineer, made incidental reference to invention as an aim in class work. Admitting that ingenuity of the highest order rests upon an incommunicable somewhat, he argued that inventiveness of a valuable kind was quite within the scope of teaching. In the department of machine design he believed lay a field for eliciting the originality of students; the several parts of a machine could be studied with a view to their improvement, and then the machine as a whole could be redesigned. Time was when it was considered artistic to give a machine or engineering structure the outlines of the Greek orders; to-day a design which is seen to be strong, rigid, and economical is found to lend itself to a beauty of form impossible to borrowed lines, however graceful in themselves.

Prof. C. A. Walcott, in his discourse on geological time as indicated by the sedimentary rocks of North America, prepared the hearer for the address of Prof. Joseph Le Conte, as retiring president, on the origin of mountain ranges. This address in matter and spirit was a master's lesson in scientific method. Without the waste of a word Prof. Le Conte lucidly explained the theory of mountain birth which science owes to him and to Prof. J. D. Dana. That sea margins have everywhere been the seat of mountain emergence was declared to be a fact of observation; that the physical cause for this fact is mainly the shrinking of a cooling and practically viscous planet, seeking equilibrium, was argued with a judicious weighing of the objections urged by T. Mellard Reade and other critics. For all the natural affection that a thinker must bear the child of his brain, Prof. Le Conte claimed no more than that the probabilities were in its favor, leaving the last and unappealable verdict to be uttered only when all the evidence has been discovered and passed upon. Contrasted with the scientific erudition of this address was Dr. D. G. Brinton's popular introduction to The Earliest Men on the following evening at the public session. Choosing apt and simple illustrations, he showed how the anthropologist, from remains which seem rather scanty, is able to piece together a picture of primitive men. That they had compassion and skill enough among them to nurse the helpless for months together was, for example, proved by adducing the bones of a man who had suffered a compound, comminuted fracture, and survived the misfortune several years.

One of the liveliest sectional discussions arose among the botanists on the reading of Prof. C. R. Barnes's paper on The Food of Green Plants, in which paper it was maintained that the protoplasm of plants and animals is identical. Prof. N. L. Britton could not see how the profound divergences between animals and plants, in their highest forms, could have arisen, except through elemental differences in protoplasm. Prof. C. MacMillan also demurred to the dictum of Prof. Barnes: animals are analytic, energy-producing; plants are synthetic, energy-absorbing; that plants have a certain superiority over animals comes out, he argued, in their comparative superabundance. In this section Prof. C. MacMillan also read a brief paper, proving how seriously botany is neglected as a study in American colleges and universities, many biological laboratories being devoted chiefly to instruction in zoölogy. The section voted that through the proper official channels the Department of Agriculture, at Washington, be requested to print and circulate Prof. MacMillan's paper.

To the chemists Prof. E. W. Morley detailed the refined methods by which he assigns to oxygen a specific gravity of 15·882, as a result of twenty recent determinations. An apparatus for ascertaining expansions was exhibited by Prof. Morley, its inventor, and Prof.

W. A. Rogers, its builder, with which a millionth of an inch can be easily measured, and with careful adjustment even one twenty-millionth of an inch. In principle the apparatus is an application of Prof. A. A. Michelson's interferential refractometer, the interference of light-waves from mirrors attached to a standard and to a compared metallic bar enabling the observer to determine minute movements with a precision hitherto impossible.

An inquiry into the properties of paraldehyde and metaldehyde by Profs. W. R. Orndorff and John White illustrated the inferences whereby the chemist is able to body forth the respective positions in a molecule of the atoms which compose it. In the Anthropological Section the songs of sequence of the Navajoes were rendered by a phonograph, an instrument which promises to be as indispensable as the camera to the serious traveler. A discussion of the most animated kind took place in this section between Rev. G. F. Wright and Mr. W J McGee on certain evidences adduced by the former of preglacial man, Mr. McGee maintaining that the evidence was merely probable and not conclusive.

### *OUR NEW INDEX.*

Half a century ago science was an affair of a few individuals, and a laboratory of any kind was to most people only a curiosity. The man who devoted himself to the study of Nature was looked upon as a visionary having neither place nor function among the contributors to human welfare; scientific methods in the arts were rarely heard of; natural knowledge had no part or place in education; and, besides an occasional learned treatise, two or three technical periodicals met all the needs of scientific publication.

But all this has now been changed. The last half of the nineteenth century will long be memorable as the period during which science achieved a prominent if not a leading place in nearly every department of human activity. The wonderful advance of discovery, closely followed as it has been by numerous practical applications, has wrought a revolution in many fields, until in the arts, in commerce, in education, and even in the professions, science may justly claim to exercise a controlling influence.

With all this there has come an enormous increase in the volume of scientific literature. Scores of scientific periodicals are engaged in the work of disseminating the results of investigation and books by the hundred are published every year in which the methods and conclusions of science are given more permanent record. The accumulation of material from this ceaseless and ever-increasing activity is already so great that ready means of access to it becomes an urgent need of the hour.

But it is only with a subdivision of this great body of knowledge that we are here specially concerned. In the early days of the scientific awakening just alluded to, it was only natural that the results obtained by workers in science should for the most part remain the possession of the student and investigator. That science, however, had a message for the people was not long in being perceived. Side by side with its many important industrial applications there had grown up a vast body of scientific knowledge only needing suitable interpretation to make it available for the masses. Under the stimulus supplied by a few enthusiastic public teachers there gradually arose a demand for this new kind of knowledge that would brook no refusal. In obedience to this desire of the public we have seen issuing from the press during the last twenty-five or thirty years a steadily growing stream of popular scientific literature embodying the ablest thought of the time, and much of it the direct product of our most distinguished scientific men.

To this class of literature The Popular Science Monthly belongs. Its special work has been to spread current scientific thought in simplified form among the people, and we may confidently claim that in no other publication can there be found a more useful, more complete, or more interesting record of the science of the last twenty years available for the general reader than is contained in the forty volumes to which our new Index is intended as the key.

To place this great store of information at the command of the intelligent reader so that he may inform himself on any given subject with the least outlay of time and attention this Index has been planned and compiled. It groups the articles so that any one looking up, for instance, Anthropology, Evolution, Manual Training, Social Science, Vivisection, can find what has appeared in the Monthly on the subject in question under that head. Practical usefulness has been put before mere logical accuracy in classification. As the Monthly is a popular magazine, popular names have been preferred to technical ones as names of classes. Thus, articles about Consumption are put under that head with a cross-reference from Tuberculosis. Cross-references from other synonyms have been liberally used.

Large aggregations of titles have been avoided by dividing subjects. Any one wishing to know what the magazine has contained on the question "Are the Planets inhabited?" would be more likely to look under planets than under astronomy; accordingly, all articles dealing exclusively with the planets, sun, moon, stars, or nebulæ are put under those respective heads, with a cross-reference under astronomy.

This Index contains a new feature that must prove of great value to users—that is, it gives the number of pages and illustrations in each article in its subject entry. By this means the searcher can see which are the most extended and instructive articles in a long list.

The titles of all books noticed in the Monthly have been entered under the subjects of which they treat, these entries being distinguished from the titles of articles by Italics. As all important books of a popular scientific character published in the past twenty years have been sent to this magazine for review, a valuable classified bibliography of popular science for that period is thus furnished.

Having adopted a new plan for the present volume, we have thought best to include in it the whole contents of the magazine from its first number. The Index of Volumes I to XX is thus superseded.

To any one who has a file of the Monthly from the beginning, this Index will be like a key to a treasure house. To any one who has not a file, but who depends upon a public library for the use of the volumes when he has occasion to read up a scientific subject, the Index will be an even more valuable possession, for it will enable him to call for the volumes he wants without loss of time.

Finally, we wish to recognize the ability of the compiler, Mr. F. A. Fernald, who, bringing to the work a large experience in indexing, has exercised the utmost care to secure accuracy and completeness, and has also suggested and carried out several improvements that will add greatly to the convenience of readers.

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## LITERARY NOTICES.

Hypnotism, Mesmerism, and the New Witchcraft. By Ernest Hart, formerly Surgeon to the West London Hospital. With Twenty Illustrations. New York: D. Appleton & Co., 1893.

This little volume consists of papers that have recently appeared in the Nineteenth Century and the British Medical Journal, and it has been published to meet the wishes of those desiring the latest informa-

tion on topics that are of current interest. Mr. Hart frankly states that he hopes the volume will serve a useful purpose in dissipating some popular errors and a good deal of pseudo-scientific superstition, superimposed on a slender basis of physiological and pathological phenomena.

His first chapter has the suggestive title of Hypnotism and Humbug, and in it he refers to the fact that hypnotism has come down to us through the ages, the lineal descendant of many ancient beliefs. He very truly says that the term "animal magnetism" applied to any of the phenomena of induced sleep, human automatism, hypnotic suggestions, or faith cures is a pure misnomer, being an example of that tendency satirized by Voltaire when he speaks of the custom of "mystics and charlatans to consecrate their ignorance and to impress its conclusions upon others *by giving a name that has no meaning to phenomena that they do not understand.*" Briefly and lucidly the physiological explanation of that more or less complete suspension of the will, known as induced sleep, is portrayed; and reference is made to the various phenomena that may be displayed by an individual under the influence of suggestion. But Mr. Hart emphasizes the fact that the allegation that an individual under the influence of suggestion has powers of clairvoyance, can predict future events, has insight into hidden things, or, in a few words, has developed new powers, is, under any and all circumstances, imposture.

The second chapter briefly refers to the ancient employment of the magnet in medicine, to Mesmer and his methods, to the "possessed" and the "demoniacs," and Mr. Hart shows that all these influences are the result of a condition of disturbed equilibrium of the nervous system and brain apparatus of the person operated on or affected therewith. A number of illustrations of postures and facial expressions of patients in the Salpêtrière Hospital in Paris are inserted and lend force to the author's thesis that most of the phenomena characteristic of the extreme degrees of hypnotization and suggestibility may occur in that condition of disturbed equilibrium of the patient, male or female, known as hysteria. In the latter condition there is often an auto-suggestion that, like the hetero-suggestion inducing hypnotism, abolishes the power of the will; and the brain losing its restraining and controlling powers, emotions may be excited, feelings induced, and intellectual operations set in motion, independently of the will of the individual as well as without individual consciousness being alive to what is going on. As to the treatment of disease by means of what has been termed "suggestive therapeutics," Mr. Hart cites Charcot, Ricker, Babinski, and Déjerine, who agree that for curative purposes hypnotism is very rarely useful, generally entirely useless, and often injurious.

The third chapter is one of the most interesting in the volume, dealing as it does with Luys's experiments at La Charité Hospital in Paris, that have been given wide publicity in general literature and that have served to originate many misconceptions regarding the phenomena of hypnotism.

Dr. Luys defines hypnotism as an extra-physiological experimental state of the nervous system, or a pseudo-sleep which is imposed and during which the subject under experiment loses the notion of his or her own existence and of the external world. He professes to create experimentally many of the disorders of mental pathology in certain stages of hypnotism, and thus to give a factitious representation of some of the disorders of madness. He presented for Mr. Hart's observation five patients that were, Mr. Hart states, profoundly neuropathic. These patients were extremely sensitive, when hypnotized, to feeble magnetic currents, to residual magnetic impressions, to magnetic effluvia, to the perception of colored luminous atmospheres radiating from and playing around the poles of a magnet or of a faradaic machine, and to flames and effluvia of like character proceeding from the features, the fingers, and the hands of the human subject. These subjects would caress with various manifestations of delight the "north pole" of the magnet, about which they saw blue flames playing, while dread and terror were produced by presenting the "south pole," about which red flames played. Even photograph paper having an impression of the "north" or "south" pole produced similar phenomena in these persons. Around the head of one of the hypnotized persons a

circlet of magnetized iron was placed that had been around the head of a person subject to hallucinations of persecution and of black misery; the patient's features became haggard, his expression melancholic, and he struggled, with evident horror and fright, to escape from imaginary persecutors; the removal of the circlet restored him to calmness. These ideas had remained stored in the circlet, as Dr. Luys informed his audience, for six months, and were apparently by no means exhausted notwithstanding frequent use. Small sealed tubes containing various medicinal substances applied to the necks of these hypnotized individuals produced symptoms similar to those caused by the administration of the substances internally. Another series of phenomena was produced by having the hypnotized person hold a glass of water or a wax doll in the hands, and their sensation was transferred to the object held so that if the glass of water or the doll was stroked, pinched, pricked, or tortured at a distance, and presumably where the subject could not see what was done, the sensation was transferred from the object to the person, who would express emotions conforming to what was done to the supposed sensitized object.

Mr. Hart found that Dr. Luys was unwilling to allow him to make certain tests that would control these experiments and determine whether the "subject" was dissembling or unconscious. Accordingly, he made arrangements to have Dr. Luys's "subjects" come to his chambers, where he had a nonmagnetic bar resembling the magnetized bar that Luys had used, a demagnetized magnet, a set of needles variously and inversely magnetized, sealed tubes containing the medicinal substances used by Luys as well as some containing water, two similar glasses of water and two similar wax dolls. In the presence of a number of credible witnesses he repeated Luys's experiments, and the "subjects" were delighted with the north pole, although there was no current turned on, and false phenomena were obtained with all the magnets employed. The doll or glass of water to which sensation had been transferred from a "subject" was surreptitiously exchanged for the unsensitized glass of water or doll, but that made no difference in the phenomena elicited by the stroking, pinching, etc. The sealed glass tubes containing water produced the tipsy scenes that arose when Luys applied to the neck the tube containing brandy, while one containing the latter produced any symptom that was expected to be obtained from whatever substance was mentioned. In other words the "subjects" were artful and efficient impostors and Dr. Luys was their dupe, as one of the "subjects" herself stated.

We believe that this brief review of the scope of the experiments justifies Mr. Hart's assertion that Luys's experiments were conducted with culpable looseness in his methods, and that there were incredible extravagance and error in the deductions that he allowed himself to make from the false phenomena to which his mode of experimentation inevitably led.

Mr. Hart believes that the alleged advantages of the therapeutic employment of hypnotism in certain neuroses, in alcoholism, and in the cases of backward or naughty children, are untenable, and that the effect of its employment is to weaken the will power that it is desirable to strengthen. In fact, compared with the hypnotist faith-curer of the hospital ward, the balance is in favor of the faith-curer of the chapel and the grotto. The latter strengthens the weaker individuality by playing upon the theme of auto-suggestion; the patient is told to believe that he will be cured, to wish it fervently and he shall be cured. And his cure is quite as real and likely to be quite as lasting as if he had become the puppet of a hypnotizer.

The method in which the subject is presented serves to convince the reader that the phenomena of hypnotism do not transcend the confines of explicable fact, and that those that believe that it contains much that is occult are but the dupes of their own credulity. The volume is written in a style that will enable the lay reader to understand the topic, and it is to be hoped that its wide circulation will correct many of the popular impressions regarding the possibilities as well as the facts of hypnotism.

Electrical Experiments. By G. E. Bonney. London: Whittaker & Co. Pp. 252. Price, 75 cents.

This book has been prepared, Mr. Bonney informs us in his preface, for the in-

structive amusement of young people in the country whose time hangs heavily on their hands in the winter evenings. It consists of a collection of simple experiments in magnetism and electricity, requiring only such apparatus as the experimenters can construct for themselves. The first class of experiments described are with permanent magnets. These are followed with a number of experiments with electro-magnets. A chapter is devoted to experiments with induction coils, in which various forms of Geissler tubes are shown and described. Most of the simpler experiments with static electricity commonly described in the text-books are given in the chapter devoted to this form of electricity, and the electrolysis of water and other liquids and the method of electro-plating in that on electrolytic experiments. Some miscellaneous experiments in thermo-electricity and with the electric light complete the book. The experiments are, on the whole, well selected to illustrate the characteristic phenomena, and are clearly described in simple terms suitable to the audience to whom the book is addressed.

How to make Inventions, or Inventing as a Science and an Art. By Edward P. Thompson, M. E. Second edition, revised and enlarged. New York: D. Van Nostrand Co. Pp. 181. Price, $1.

In his preface Mr. Thompson says that his object is "to establish inventing as a science." In the first chapter he advances excellent reasons for his claim that this may be done, but he does not carry out his reasoning logically. For instance, in the fourteenth chapter the author says that although "Coster was the first to conceive the idea of replacing handwriting by printing," his discovery was "knowledge, not an invention." Science is knowledge, and the application of it to a hitherto unknown art surely might be construed an invention. Nevertheless, Mr. Thompson has given to the world in this book a fund of useful and interesting information which can not fail to be of benefit. It contains some very excellent advice to those who "have ideas," and if only his suggestions were adopted many a tyro inventor would be saved a good deal of both worry and useless expense.

The chapter entitled Suggestive Ideas is full of valuable promptings and advice. So is Chapter VII. In the latter the author lays down four rules which should be observed by inventors. The first rule says, "Do not begin with intricate problems." The others warn inventors against confining themselves to single devices, and exhorts them to "practice medium problems," and study the analysis of the methods by which they desire to accomplish new results.

In the chapters on Principles in Chemistry and Electricity "for making scientific inventions" Mr. Thompson has treated the probabilities of invention with the assistance of these great factors, besides giving a large fund of useful information regarding these elements in the field of invention. The major part of the volume treats of the possibilities of invention in the field of electricity, and consists for the most part of selections from the author's writings upon this subject in the Electrical Engineer and other scientific journals.

Mechanics and Hydrostatics. By S. L. Loney. Cambridge: University Press. 1893. Pp. 304. Price, $1.25.

Prof. Loney has prepared this little manual for the use of beginners, and presumes on only a limited mathematical knowledge by the pupil. The subject-matter comprises statics, dynamics, and hydrostatics, which are treated briefly and concisely, the propositions being illustrated by appropriate examples. A number of selected problems are appended to each chapter for the student to work out, the answers to which are given at the end of the book. In an appendix a sufficient exposition of elementary trigonometry is given to enable the student to follow the text when the mathematical treatment calls for more mathematical knowledge than elementary geometry and algebra.

The Mineral Industry: its Statistics, Technology, and Trade, in the United States and other Countries, from the Earliest Times to the End of 1892. Vol. I. Edited by Richard P. Rothwell. Pp. 628. New York: Scientific Publishing Co., 1893.

This volume is a compilation of statistics, essays, and general information concerning the mineral industries of the United States and of the world, which will be gladly wel-

comed by all persons interested in the mineral resources of this country.

It is the most comprehensive work of this nature which has ever been put before the public. All puzzling measurements of quantity, etc., are reduced to the metric system, and the student can readily examine the progress of the different industries, from their earliest conception to the present time. The articles on aluminum, tin, chronology of the gold and silver industries, and the platinum group of metals are very important additions to the exhaustive statistical body of the work. The histories of the progress of metallurgy, assaying, etc., are also ably treated; and in the various papers on copper we have a perfect encyclopædia of the history, progress, values, and modes of producing this metal, which can not fail to be of great benefit to everybody interested in industrial progress.

Considering the ambitious plan of the compilation it is somewhat unfortunate that provision was not made for articles upon the *uses* of the precious and other metals, with a few tables showing their quantitative applications. Iron, lead, and nickel occupy a considerable portion of the work, and a wonderful amount of information can be learned about these metals and the progress of their production from the exhaustive tables that accompany the text. The onyx industry is rather summarily treated; but it appears that a difficulty existed in obtaining sufficient important data to make that article more interesting. Mr. Rothwell is to be congratulated upon the very useful volume which he and his assistants, Messrs. Benedict, Ingalls, Church, Hofman, etc., have produced.

Old and New Astronomy. By Richard A. Proctor, completed by A. Cowper Ranyard. London and New York: Longmans, Green & Co. Pp. 816. Price, $12.

At the time of the author's death, in 1888, about half of this volume had been published in parts, and about one third more was written, though incompletely. Mr. Proctor intended it to be the great work of his life, and to this end had been collecting material for more than twenty years before he began its publication. The chapters which he left in manuscript have been completed by Mr. A. Cowper Ranyard, Mr. Proctor's successor as editor of Knowledge, who has also written the part on the stars needed to fill out the plan of the work. As implied in its title, "Old and New," this treatise essays to give the notions of ancient astronomers as well as the present state of the science. The author has made a practice also of telling when, where, and by whom important discoveries and advances in our knowledge of the heavens have been made, and in this way has added much of the charm of narrative to his book. The large type, many illustrations and maps, and fine paper also contribute to make the volume an attractive one. The frontispiece consists of three views of pyramids, and in the first chapter, devoted to Ancient and Modern Methods of Observing the Heavenly Bodies, the use of the pyramids and other structures of masonry for this purpose is explained. In the same chapter are described the quadrants and astrolabes of the middle ages, and the most modern transit and equatorial instruments as well. The shape of the earth is the first subject taken up after the description of instruments. Under this head the various proofs that the earth is round are given, and the processes employed for measuring its curve are set forth. The third chapter is devoted to Apparent Motions of the Sun, Moon, and Planets, and is copiously illustrated with charts and diagrams. The author next describes the True Mechanism of the Solar System, and here has occasion to dip quite deeply into history in order to give the successive approximations to the truth arrived at by the early astronomers. He follows this account with a statement of the methods that have been devised for measuring and weighing the solar system. The sun, the moon, and each of the planets are fully described, a notably interesting chapter being made on sun-spots and solar prominences under the title The Sun's Surroundings. When his labors were broken off by his unexpected death Mr. Proctor had written nothing on the stars, the nebulæ, or the Milky Way, though it was known that he intended to make these sections a special feature of the book. It was in this department of astronomy that his own work was of most original and lasting character. Mr. Ranyard has sought to follow out the author's general

plan in the stellar section of this treatise by giving as complete a review as he could of the various theories which have been advocated with regard to the Milky Way and the distribution of stars and nebulæ. A feature of the book is the explanatory notes at the foot of nearly every page, and in these notes, throughout Mr. Proctor's chapters, are often to be found vigorous criticisms of words, things, and men which are notably characteristic of the author. The volume is indexed, and the illustrations comprise 31 plates and 472 wood-cuts.

Handbook of Greek and Latin Palæography. By Edward Maunde Thompson, D. C. L., etc. The International Scientific Series, Vol. LXX. New York: D. Appleton & Co. Pp. 343. Price, $1.75.

The general reader will begin to have some fellow-feeling with the delver among ancient manuscripts after he has read this book, and learned something about the materials and implements used by scribes of different periods, the successive changes in the forms of the alphabetic characters, the various styles of handwriting characterizing different times and localities, and the numerous other features that aid in deciphering, and in deciding as to the age and genuineness of a given document. The author describes the Greek and the Latin alphabets, and gives charts showing the forms of script letters at different periods, and how the Latin alphabet was derived from the Egyptian hieroglyphs, through the hieratic, the Phœnician, and the Greek. Among the materials used to receive writing he enumerates leaves, bark, linen, clay, metals, both plain and waxed wooden tablets, papyrus, skins, parchment, vellum, and finally paper. The letters were scratched on waxen tablets with a sharp-pointed stylus; on papyrus they were traced in ink with a reed. The old form of a book was the roll. After the practice of hinging two or more tablets together in a "codex" arose, vellum books took on this more convenient shape. The further transition to the modern bound volume was easy. Naturally the ancient scribes sought to diminish their toil by abbreviations and contractions of words. These abbreviations form one of the chief difficulties that a person meets with when he begins to read Latin and Greek manuscripts, and a large number of them are explained by Mr. Thompson. In describing the several styles of Greek writing Mr. Thompson divides manuscripts written on papyrus from those on vellum. He considers first the book hand on papyrus, next the cursive hand on the same material, then the uncial hand on vellum, and lastly the mediæval minuscule writing. A similar course is taken in tracing the history of Latin palæography: The two branches of majuscule writing—capitals and uncials—form the first division, then come the modified uncial, mixed hands, and the half-uncial. Roman cursive writing is next taken up, descriptions of the national minuscule hands derived from it follow, and the history is brought down to include English charter hands of the fifteenth and sixteenth centuries. In these chapters, which constitute two thirds of the work, is seen a striking instance of the aid which physical science is giving to all branches of research and endeavor. Photographic engraving, by means of which the author puts before his readers actual facsimiles of a large number of styles of ancient writing, alone makes possible a really instructive book on this subject at a moderate price. These facsimiles enable us to compare, side by side, specimens from manuscripts which lie scattered in the different libraries of Europe, and which could never have been brought together. The volume has an index, and a list of the principal palæographical works used or referred to by the author is appended.

Poole Brothers' Celestial Planisphere. Drawn and compiled by Jules A. Colas. Price, $3.—Poole Brothers' Celestial Handbook. Compiled and edited by Jules A. Colas. Pp. xiv + 110. Price, $2. Chicago: Poole Brothers.

The planisphere published by Messrs. Poole Brothers consists of the usual map of the constellations on a disk nineteen inches and a half in diameter, revolving under a screen. A skeleton screen is used, so that besides the constellations visible in the sky nearly all the others on the map can be seen. Disk and screen are mounted on a heavy sheet of cardboard, which slips into a substantial cardboard case.

The Celestial Handbook is intended as a companion to the planisphere, and has been compiled especially for the use of amateurs

in the study of astronomy. An introduction containing explanations and definitions is followed by systematically arranged data concerning the constellations. The data are accompanied by diagrams and illustrations, and consist of a short history of each constellation, a catalogue of the stars, with their designations, magnitudes, and positions, and notes on the principal curiosities contained in the constellations. Following this portion of the book are tables of old and new constellations, names given to the principal stars, etc. There are also brief chapters on shooting stars, star showers, comets, and the planets. The text is illustrated with one hundred and forty cuts.

Some Hints on Learning to Draw. By G. W. Caldwell Hutchinson. London and New York: Macmillan & Co. Pp. 199. Price, $2.25.

The first "hints" given in this book relate to the reasons why drawing is an art that every one should desire to be acquainted with. There is the story of James Nasmyth, who, being in Sweden, where the party of either side could not understand the language of the other, secured a good supper by drawing its principal features, and got his other wants satisfied in a like way, with great admiration on the part of his hosts. The "graphic" language is thus evidently a universal one. Drawing is of first importance to architects, in teaching them to see artistically, without which they can not build artistically. It is a momentous aid in the cultivation of the observing powers, and "practically the first step in drawing is to learn to see accurately." One of the earliest lessons to be learned is "how very untrustworthy is the testimony of the untrained eyesight; when this is realized, the importance of keen observation becomes apparent." Erroneous conceptions, which are among the great difficulties in the way of good drawing, must be got rid of, for which purpose the student should be placed face to face with the object as soon as possible. Care should be taken to have the best specimens of the model obtainable. Freehand outline copies from the flat may, with advantage, be alternated every now and then with outline drawings from objects, so that we, by seeing and working from good copies, may have a high standard before us to show what our own work should be like. From the drawing of such common objects we may pass to outline drawings from casts of leaves or fruit, and thence to outlines from natural leaves and growing plants and shells, and casts from the antique. The time is not wasted that is spent in striving to do everything as thoroughly as possible, even the smallest thing. It follows from any fair consideration of the subject that there is no simple road, no one process or rule by which success may be obtained in drawing. Another important reason why every one should learn to draw and so learn to see, is in order that our taste for what is really good may be improved. The student is led from the opening story and these interesting considerations to the practical maxims and their application, which are given in a plain style, and are illustrated by numerous diagrams and by drawings from a group of living artists of the first rank.

Report of the United States National Museum. For the Year ending June 30, 1891. Washington: Government Printing Office. Pp. 869.

The catalogued collections in the museum now number 3,028,714 specimens, having increased about nineteen fold during the past ten years. It is observed, however, that a large portion of the material catalogued in 1884 and in later years has been in the custody of the Smithsonian Institution for several years, but in storage. There are now thirty-three organized departments and sections in the museum, under the care of curators, including honorary and acting curators and assistant curators. In the division of anthropology progress in the ethnological department has been satisfactory; the collection in prehistoric anthropology has been reclassified and rearranged according to locality, and special researches have been pursued in many directions. In forestry a systematic display of the more important lumber trees by means of maps showing their distribution, photographs of typical trees, and photomicrographs, has been begun. The zoölogical, botanical, mineralogical, and geological collections have been increased in nearly every department. The largest gift to the library during the year was from the Rev. John Crumbie Brown, of Scotland, of

the professional library of his brother, the late Dr. Samuel Brown, who has been called "the last of the alchemists," from his advocacy of a belief in the transmutability of the elements. The work of issuing the publications is now more punctually performed than heretofore. One of the aims of the museum —to aid students and others engaged in scientific work by lending them material to be used in their researches—has been carried out in a number of loans; and other students have availed themselves of the privilege of examining the collections. A summary is given in the report of the cases of co-operation with the work of the museum by various departments and bureaus of the Government, from which many valuable results have accrued. The papers contributed by members of the museum staff describing and illustrating the collections include The Genesis of the National Museum, by G. Brown Goode; Ethnological Collections in the United States National Museum from Kilimandjaro, East Africa, by Dr. W. L. Abbott; The Bernadon, Allen, and Jouy Korean Collections in the United States National Museum, by Walter Hough; Shinto, or the Mythology of the Japanese, The Ancient Burial Mounds of Japan, and Some Ancient Relics in Japan, by Romyn Hitchcock; Prehistoric Naval Architecture of the North of Europe, by George H. Boehmer; and First Draft of a System of Classification for the World's Columbian Exposition, by G. Brown Goode.

Lectures on Sanitary Law. By A. Wynter Blyth. New York: Macmillan & Co. Pp. 287. Price, $2.50.

These twelve lectures were delivered by the author at the College of State Medicine, as part of the usual course of instruction in sanitary science. They are republished on account of their possible value to those who desire to obtain, in a small compass, a general view of the powers and duties of (English) local authorities in relation to the public health. Having described the division into sanitary districts and the functions of authorities, the lectures concern Nuisance; Sewerage and Drainage; Water; Sanitary Appliances, Regulations, and By-laws; Statutory Provisions with Regard to the Prevention of Disease; the Law under the Infectious Diseases Notification and Prevention Acts; Port Sanitary Law; the Housing of the Working Classes Act, 1890; Canal Boats and Metropolitan Sanitary Law. In the appendix are given examples of by-laws relating to offensive trades, with other matters, and the statutes specially treating of the inspection and examination of food.

The eighth volume of the *Mineral Resources of the United States*, compiled by *David T. Day*, Chief of the Division of Mining Statistics and Technology, contains 630 pages of statistical data relative to the progress made from year to year in the production of minerals. A complete statement of the mineral products of 1891, with comparative tables, occupies the greater portion of the volume, the remainder being devoted to a very important examination of the new discoveries of mineral deposits and explanations of improved technical processes by which minerals have been made more available and the yield increased, etc. The summary shows an increase in value in the entire mineral products of $9,501,139 over 1890, chiefly in silver, copper, lead, and coal, the iron and steel production having fallen off nearly one million tons in 1891. Washington, 1893.

In Bulletin No. 3 of the United States Department of Agriculture, 1893, *A. K. Fisher*, M. D., Assistant Ornithologist, contributes an interesting report upon the *Hawks and Owls of the United States.* From an examination of seventy-three species and subspecies of these birds, Dr. Fisher has arrived at the conclusion that instead of their being pests or enemies, all except six species of the hawks and owls of this country are really among the farmer's best friends. This conclusion was arrived at after an examination of the stomachs of 2,700 of these birds, when it was found that the principal food of sixty-seven of the species examined, comprising 2,212 birds, consisted of "mice and other small mammals" which are a constant source of annoyance and loss to the farmer. The work, which is illustrated with twenty-six colored plates, is a valuable contribution to the natural history literature of the country, and can not fail to be widely appreciated by ornithologists and lovers of the feathered tribe. The color, food, locality, and habits of each of the seventy-three species are de-

scribed. Pp. 210. Department of Agriculture, Washington.

Mr. *Marsden Manson*, C. E., has published an interesting little book entitled *Geological and Solar Climates, their Causes and Variations.* In it he attacks the published opinions of some of the most eminent students and writers of geology, and, although he admits that the direct cause of the Glacial epoch or Ice age was a decrease in the original heat of the globe, he scores those scientists whose researches established that fact because they failed "to account for all the phenomena accompanying the Ice age, or to account for the disappearance of that age." Mr. Manson's theory is that the direct cause of the glaciation was the exclusion of solar heat from those regions where the ice development was taking place, and that the disappearance of the ice northward and southward was caused by the natural earth heat breaking through the ice crust, after which, assisted by the solar agencies, it began to gather heat and dispersed the cold toward the arctic and antarctic regions relatively as the land area predominated. The book is for sale by William Doxey, 631 Market Street, San Francisco. Price, 75 cents.

Volume X of the *United States Fish Commission Bulletin* is an important contribution to the scientific and industrial literature of the fishes and fisheries of the country. Besides articles on The Oyster and Oyster-culture, by Bashford Dean, which have already been noticed in these pages, it contains a valuable paper on the Fishing Vessels and Boats of the Pacific Coast, by Captain J. W. Collins; a report on the fisheries of the New England States; and various articles and reports on the aquaria of the United States Fish Commission and the conditions of the fisheries of Kentucky, Iowa, Lake Ontario, etc.

In the article on the Fishing Craft of the Pacific Coast, besides a fund of useful information and suggestion, Captain Collins describes the appearance, construction, and sea-going qualities, as well as their general adaptability to the several fisheries, of all kinds of boats and vessels, from the Alaskan *kaiak* (canoe) to the perfectly appointed whaler, and illustrates the text by thirteen plates and four figures. The fisheries of the New England States are also exhaustively treated, the report chiefly consisting of statistical tables of their condition, with an analysis of the quantities of the various fishes captured, the number of men and boats engaged, and the amount of capital invested.

In the report of the fisheries of Lake Ontario, Hugh M. Smith, M. D., gives an interesting account of his investigations, which were made with a view to the establishment of a fish-hatching station on the lake. The volume is fully illustrated with ninety-four full-page plates and ten figures in the text. Pp. 436. Washington, 1892.

*A Concise History of Religion* has been prepared by *F. J. Gould* for the issues of the Rationalist Press Committee of London. In the first volume, the only one that yet appeared, are given brief accounts of the principal religions of the world except Judaism, Christianity, and Mohammedanism, preceded by an analysis exhibiting the chief phases of primitive worship, and the main lines of religious development. The list of religions treated include about fifty. The author proposes to follow this volume with other parts dealing with the Bible, Judaism, Christianity (from the point of view of a purely human origin), and modern Rationalism. (London: Watts & Co.)

The book *Hermetic Philosophy*, vol. iii, "A comedy founded on Plato's Meno, applied to modern discoveries in theosophy, Christian science, magic, etc., and to those who are seeking these discoveries," bearing the signature of Styx, and published by the J. B. Lippincott Co., Philadelphia, discusses the question, "Can virtue and science be taught?" There is a vein of levity running through the whole, yet the author's purpose appears to be serious. He has taken Plato for his pattern and applied his mode of illustration to modern mental phenomena—to the discussion of "the merits of a few self-appointed leaders among the thousands of those who feel that there is a call in the mind for them to begin on the 'mighty work.'" Among these pretenders are named "Adepts, Hon. Magi, Mahatmas, Children of the Sun, the Divinely anointed," and Christian scientists. The author's point of view is indicated by the question, "Is not the man who presents himself for common spectacle as one pos-

sessing gifts direct from the hand of God, for which he is a specially selected and ordained recipient, either a fool, a fanatic, or a rascal?"

The *Religious Herald* (Hartford, Conn.) presents to its subscribers as a souvenir of fifty years' publication of the paper, a large and profusely illustrated volume entitled *Picturesque Chicago and Guide to the World's Fair*. It consists of descriptions of the city, its parks, benevolences, business houses, institutions, and other peculiar features, illustrated by more than fifty photographic reproductions. The mechanical execution is of the most pleasing character.

A view of what some socialistic agitators might do if they had opportunity is given in a little book entitled *Is it Right to rob Robbers?* by *Morrison L. Swift*, published by the Commonwealth Society, Boston. The "robbers" of the story are capitalist employers. A plot formed by a few clerks to steal regularly from the moneys of their concerns and distribute the sums among the needy, spreads till it includes nearly all the employed and vast corporative concerns have been built up out of the proceeds, "labor" has found its level as high as capital, and all of society—manufacturers, the legal profession, education, and what not—are affected by the conditions developed. Detection comes at last; capital shows its cruel hand in the prosecution of the thieves, now numbering many thousands; convulsions and almost revolution follow, till at last insolent capital is forced to yield and share in the universal partnership.

No. 10 of the third volume of *Werner's Readings and Recitations*, compiled and arranged by *Caroline B. Le Row*, (quarterly, Edgar S. Werner, 28 West Twenty-third Street, New York), is known as America's Recitation Book, and includes pieces, by American authors only, on great events in the history of our country, arranged according to the chronology. The pieces are classified as relating to Discoveries, Settlements, French and Indian Wars, Revolutionary War and Declaration of Independence, the War of 1812 and the Mexican War, and the Civil War and Emancipation Proclamation.

The *Conversations on some of the Old Poets* were published by Mr. *J. R. Lowell* in 1845, and again in a revised edition in 1846; and were reprinted in London in 1845. They were afterward allowed to pass out of print. Mr. Lowell did not include them in his collected works, regarding them as in a measure superseded by his later and more mature writings on like subjects. They have, however, a value and interest that have not been lessened by time or by the author's growth in fame; and although a self-restraint with which we can find no fault may have prevented the author from pressing his thoughts on the same subjects twice upon the public, often greatly modified the second time and perhaps contradictory of the first impression, such scruple need not now exist to exclude the reading public from what is really a very enjoyable and instructive series of essays. The conversational form was adopted partly because the essays were discursive, and partly to enable them to be so without violation of the canons of literary propriety. They have their faults, which appertain to the youthfulness of the author at the time he wrote them; but, as the present publishers well say, Mr. Lowell's reputation can better afford the faults than our literature can afford the suppression of the work. The present edition is published, with an introduction by Robert Ellis Thompson, by David McKay, Philadelphia.

## PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins: Michigan. Potatoes, by P. M. Harwood. Pp. 20.—Massachusetts. Meteorological Summary. May and June, 1892-1893. Pp. 8.—Iowa. Various Articles. Pp. 84.

"A. L. A." Library. Catalogue, 5,000 volumes for a Popular Library. Washington: U. S. Bureau of Education. Pp. 260.

The Altruistic Review. Monthly. Chicago. Pp. 45. 20 cents; $2 a year.

American Chemical Society. Journal. March, 1893. Pp. 40. $5 a year.

Arnold, Matthew. Sohrab and Rustum. American Book Company. Pp. 44. 20 cents.

Beal, Dr. W. J. Report of the Botanical Department, etc., University of Michigan Pp. 37.

Bolton, Henry Carrington. A Select Bibliography of Chemistry, 1492-1892. Washington: Smithsonian Institution. Pp. 1212.

Bottome, S. R. Electricity and Magnetism. A Popular Introduction. Macmillan & Co. Pp. 203. 90 cents.

Bradley, F. H. Appearance and Reality. Macmillan & Co. Pp. 558. $1.75.

Clerke, Agnes M. A Popular History of Astronomy during the Nineteenth Century. London: Adam and Charles Black. Pp. 573.

Cleveland, The Duchess of. The True Story of Kaspar Hauser. Macmillan & Co. Pp. 112. $1.50.

Cummins, W. F. Notes on the Geology of Northwest Texas. Austin: Geological Survey of Texas. Pp. 60.

Dean, Bashford. Report on the European Methods of Oyster Culture. Washington: United States Fish Commission. Pp. 48, with Plates.

Emerson, Ralph Waldo. The American Scholar, Self-Reliance, Compensation. American Book Company. Pp. 108. 20 cents.

Employer and Employed. Quarterly. Pp. 16. Boston: George H. Ellis. 10 cents; 40 cents a year.

Fernow, B. E. Report of the Chief of the Division of Forestry for 1892. Washington; Government Printing Office. Pp. 64.

Fitting, The Principle of. By a Foreman Pattern Maker. Macmillan & Co. Pp. 313. $1.50.

Ginn & Co., Boston. Bulletin of Publications in the Modern Languages.

Graham, Douglas. Recent Developments in Massage. Detroit, Mich.: George S. Davis. Pp. 128. (Physicians' Leisure Library. $2.50 a year.)

Grinnell, George Bird. Pawnee Mythology. Pp. 17.

Harkness, James, and Morley, Frank. Theory of Functions. Macmillan & Co. Pp. 507.

Harper, W. R., and Castle, C. F. Greek Prose Composition. American Book Company. Pp. 127. 75cents.

Harrington, C. W. Report of the Chief of the Weather Bureau for 1892. Washington: Government Printing Office. Pp. 80.

Harris, W. T., Commissioner. Report of the Commissioner of Education, 1889-'90. Washington: Government Printing Office. 2 vols. Pp. 1724.

Hawkins, C. C., and Wallis, F. The Dynamo; its Theory, Design, and Manufacture. Macmillan & Co. Pp. 520.

Hayes, M. H. The Points of the Horse. Macmillan & Co. Pp. 38. $10 50.

Himes, Prof. C. F. The Scientific Expert in Forensic Procedure. Pp. 32.

Hollick, Arthur. Contribution on Cretaceous Formation of Long Island and Eastward. Pp. 16, with Plates.—Plant Distribution as a Factor in the Interpretation of Glacial Phenomena. Pp. 16.

Horsford, E. N. and Cornelia. Leif's House in Vineland.--Graves of the Northmen. Boston: Damrell & Upham. Pp. 40, with Plates.

Imperial University of Japan. Journal of the College of Science (Anatomy of the Limproliaceæ, by Sadahisa Matsuda). Pp. 36, with Plates.

Johnston, W. J. Elementary Treatise on Analytical Geometry. Macmillan & Co. Pp. 425.

"Land, The, shall not be sold forever." Reprint from Canadian Methodist. Quarterly. Pp. 8.

MacDonald, Arthur. Abnormal Men. Washington: Bureau of Education. Pp. 445.

Mach, Dr. Ernst. The Science of Mechanics. Chicago: Open Court Publishing Company. Pp. 534. $2.50.

Magazine and Book Reference. Quarterly. New York: Society of Pedagogy. Pp. 8.

Maginnis, A. J. The Atlantic Ferry. Macmillan & Co. Pp. 208. 75 cents.

Marlatt, C. L. Report on Useful and Injurious Insects, etc. Pp. 32.—Report on Wine-making in France. Pp. 60.

Martin, H. T. Castorologia (the Canadian Beaver). Montreal: William Drysdale & Co. Pp. 238.

Massachusetts Institute of Technology, Boston. Description. Pp. 39.—Annual Report. Pp. 81.—Annual Catalogue. Pp. 256.

Maycock, W. P. Electric Lighting and Power Distribution, Part III. Macmillan & Co. Pp. 148, with blanks. 75 cents.

Morrow, J. T., and Reid, Thorburn. Arithmetic of Magnetism and Electricity. Lynn, Mass.; Bubier Publishing Co. Pp. 145. $1.

New England Weather Service. Bulletin for June, 1893. J. W. Smith, Director.

Newton, Alfred, and Gadow, Hans, and others. A Dictionary of Birds. Part I, A to G. London: Adam and Charles Black. Pp. 304. $2.60.

North Dakota Weather and Crop Service. June, 1893. Bismarck. Pp. 15, with Plate.

Oaspe, Selections from. Book of Cosmogony and Prophecy. Boston. Pp. 23.

Riley, C. V. Report of the Entomologist, United States Department of Agriculture for 1892. Pp. 30, with Plates.—The Yucca Moth and Yucca Pollination. Pp. 60, with Plates.—Parasitism in Insects. Pp. 35.—Various Papers on Lachnosterna; A New Herbarium Pest; Certain Peculiar Structures of Lepidoptera; The Department of Agriculture and Apiculture; The Elm-leaf Beetle; Coleopterous Larvæ; New Species of Prodoxidæ; On the Ox Bot in the United States. Pp. 4 to 16 each.

Ritchie, David G. Darwin and Hegel. etc. Macmillan & Co. Pp. 285.

Savage, R. H. The Passing Show. New York and Chicago: F. Tennyson Neely. Pp. 326. 50 cents.

Society, The, for Psychical Research. Transactions. June, 1893. London. Pp. 234. 3s. 6d.

Stowell, C. H., Editor. Food. Monthly. New York: The Clover Publishing Co. Pp. 48. 20 cents. $2 a year.

Swinton, William. A School History of the United States. American Book Co. Pp. 383. 90 cents.

Tebb, William. The Recrudescence of Leprosy. London: Swan, Sonnenschein & Co. Pp. 412.

Technical Society of the Pacific Coast. Transactions. San Francisco. Pp. 60.

Thorpe, F. N. Benjamin Franklin and the University of Pennsylvania. Washington: Bureau of Education. Pp. 450, with Plates.

Thorpe, J. E. A Dictionary of Applied Chemistry, Vol. III. New York: Longmans, Green & Co Pp. 1058. $20.

Topinard, Dr. Paul. L'Anthropologie aux États Unis (Anthropology in the United States). Paris. Pp. 48.

United States Geological Survey. Report for 1889-'90. 2 vols. Pp. 757 and 395.—Lesquereux's Flora of the Dakota Group. Pp. 397.—Papers on the Geology of New Jersey, by R. P. Whitfield. Pp. 402.—Bulletins, 82 to 85, and 90 to 96 (Correlative Papers on the Cretaceous, by C. A. White; on the Eocene, by W. B. Clark; on the Neocene, by W. H. Dall; on the Newark System, by I. C. Russell; Report of Work done in Chemistry and Physics, by W. F. Clarke; Record of North American Geology for 1890, by N. H. Dayton; the Compressibility of Liquids, by Carl Barus; Insects from the Tertiaries of Colorado and Utah, by S. H. Scudder; The Mechanism of Solid Viscosity, by Carl Barus; Earthquakes in California in 1890 and 1891, by E. S. Holden; The Volume Thermodynamics of Liquids, by Carl Barus).

United States National Museum Publications. A New Species of Cyprinoid Fish, by D. S. Jordan; Diatomaceæ from off Delaware Bay, by Albert Mann; Throwing Sticks from Mexico and California, by O. T. Mason; The Gray Shrike, by Leonhard Stejneger; Erian (Devonian) Plants, etc., by D. P. Penhallow; Report on Actiniæ, by J. P. McMurrich; Fossil Plants from the Fort Union Group, Montana, by F. H. Knowlton.

United States Navy. Catalogue of the Exhibits in the Museum of Hygiene, Medical Department. Compiled by P. S. Wales. Pp. 136.

Ward, C. J., Honorary Commissioner. Jamaica at Chicago. Pp. 95, with Map.

Warden, Florence. A Terrible Family. New York: International News Company. Pp. 311. 50 cents.

Weld, L. G. A Short Course in the Theory of Determinants. Macmillan & Co. Pp. 238.

Wickersham, James. Tacoma, Wash. Is it Mount Tacoma, or Rainier? Pp. 34.

World's Columbian Exposition. Department of Engineering. Official Programme. Pp. 32.

Wright, C. H., and Dewar, O., Editors. Johnson's Gardener's Dictionary. New revised edition. Part II. Macmillan & Co. Pp. 128. 40 cents.

## POPULAR MISCELLANY.

**Notes from the Madison Meeting of the American Association.**—At the Madison meeting of the American Association for the Advancement of Science, the pressing necessity for giving availability to the world's wealth in scientific literature was discussed. In the Botanical Section was suggested the desirability of a bibliography for botany such as that compiled for chemistry by Prof. H. Carrington Bolton. It was further proposed that the bibliographical volumes be supplemented by a serial index. In the Mechanical Section Mr. C. Wellman Parkes, of Troy, N. Y., outlined a weekly index to periodicals which he promises to establish in New York with the new year. During each quarter the numbers will successively recapitulate all the titles from the beginning of the quarter. At the end of the sixth, ninth, and twelfth months special numbers will recapitulate all the titles from the beginning of the year. The reclassifications needed for this index are to be rendered easy by adopting a machine casting each title as a solid line of type metal.

Prof. Bolton's bibliography of chemistry is published by the Smithsonian Institution. At the recent Congress of Librarians in Chicago it was stated that this institution may publish other similar bibliographies for which manuscripts may be prepared by learned societies. As a good many of these societies have moderate funds available for the purpose, and as societies still more numerous could arrange for gratuitous co-operation, on the plan of the American Library Association with its index to periodicals, the impulse to organization seems to be all that is lacking in order to supply a crying need of the times.

Prof. Edward Hart, of Easton, Pa., adverted to the importance of mechanical aids in analytical chemistry. Balances, he said, are now made with short arms, and are in consequence more rapid. They are provided with agate knife edges to resist corrosion, with aluminum beams for lightness, with better weights, with improved beam and pan arrests. The torsion balance, due to Dr. Alfred Springer, of Cincinnati, enables a heavier load to be weighed with greater sensitiveness. The Gibb ring-burner much improves the Bunsen lamp: it allows the upper part of a crucible to be heated so that liquids boiling at high temperatures may be evaporated without spattering.

Prof. T. M. Drown, of Lafayette College, first used, in 1875 or 1876, the crucible with perforated bottom which, reinvented in 1879 by Prof. F. A. Gooch, with the addition of asbestos felt, is invaluable in certain analyses. Filters of paper, when unsatisfactory, can be replaced by Gibbs's sand filter, Munroe's clay filter, and Carmichael's siphon filter. The chemist with recent years has added two metals to the list from which his vessels are drawn—nickel and aluminum. In the cheap and ready supply of reagents, which a few years ago were troublesome to make and costly of purchase, industry has done an important service to research; to-day hydrogen dioxid, bromin, and potassium permanganate are articles of commerce and bear moderate prices.

Prof. E. L. Nichols, of Cornell University, referring to the phenomena of alternating currents, said that their complexity had obliged the modern electrician to be both a mathematician and a physicist. In much the same way a generation ago the new and difficult phenomena of cable telegraphy served to train the men who stand as pioneers and chieftains in electrical science.

Prof. W. H. Brewer, of New Haven, Conn., speaking of stock-breeding, said that as long ago as 1812 a thousand guineas had been paid in England for a short-horn bull. The Short-horn Herd-book, published in 1832, and the Stud-book, yet earlier, had laid the foundation for the science of heredity in part by proving that cross-breeding induced variability. Within the modern era the only additions to domesticated animals have been the canary and the ostrich.

As showing how far mechanical and chemical economy has saved labor on the farm, Prof. Brewer cited Johnson, who estimated fifty years ago that ninety per cent of the capital of the United States was invested in farming; to-day the proportion has fallen to one third.

**Anthropological Material.**—In his anniversary address as President of the Anthropological Institute of Great Britain and Ireland, Prof. E. B. Tylor remarked on the fear felt by some that one of the main topics of anthropology would before long dwindle or disappear. When the savages and barbarians are disposed of by civilization or extirpation, their anthropological material is more or less exhausted. At present, however, this is so far from having happened that the supply is on the whole better and more plentiful than ever. With many tribes, indeed, the record is closed, as with the Tasmanians, those representatives of the palæolithic age in modern times, who can give us few more details of the lowest known stage of culture beyond those collected by Mr. Ling Roth. Not to give a whole list of modern works, it is enough to say that for minutely accurate accounts of uncultured life, none excel Codrington's Melanesians and Kubari's treatise on the Pelew Islanders, and we can only regret that the anthropologists of past centuries were not alive to the need of such minutely careful study of the tribes who were then, but are not now, in a state to be thus studied. One class of anthropological material, of which the quantity available has only lately been appreciated, is folk lore. When, fourteen years ago, the speaker took part in founding the Folk-lore Society, for the preservation and publication of popular traditions, legendary ballads, local proverbial sayings, superstitions, and old customs, and all subjects relating to them, he as little as others anticipated how many volumes of such matter it would produce, or of how great value they would be, as to the main purpose of tracing the development and diffusion of popular tradition and fancy, and as to the incidental knowledge of man which is preserved in them. Especially to students of the development of ethical ideas, folk-lore studies are exceptionally valuable, recording as they do in their incidents what were the ideas on good and bad actions, not indeed of the age in which the stories are gathered, but of a remote past kept thus in memory. Speaking of the reports of investigations among the Indians of Northwest America, Prof. Tylor said it was a ground of satisfaction, in looking through them, to feel that a systematic account of the anthropology of British Northwest America is to a great extent completed. "Not that everything requiring record has been recorded. Observation of rapidly changing native life will still tax to the extreme the efforts of the anthropologists of the Canadian Dominion, but it is a great work to have the framework already set up to be filled in future years."



**Officers of the American Association.**—The next meeting of the American Association for the Advancement of Science is to be held August 16 to 22, 1894, probably in Brooklyn, N. Y., under the presidency of Daniel G. Brinton, of Media, Pa. The following are the vice-presidents and secretaries of sections and general officers elect: *Vice-Presidents:* (A) Mathematics and Astronomy—George C. Comstock, Madison, Wis.; (B) Physics—William A. Rogers, Waterville, Me.; (C) Chemistry—Thomas H. Norton, Cincinnati, Ohio; (D) Mechanical Science and Engineering—Mansfield Merriman, South Bethlehem, Pa.; (E) Geology and Geography—Samuel Calvin, Iowa City, Iowa; (F) Zoölogy—Samuel H. Scudder, Cambridge, Mass.; (G) Botany—Lucien M. Underwood, Greencastle, Ind.; (H) Anthropology—Franz Boas, Worcester, Mass.; (I) Economic Science and Statistics—Henry Farquhar, Washington, D. C. *Permanent Secretary:* F. W. Putnam, Cambridge (office, Salem), Mass. *General Secretary:* H. L. Fairchild, Rochester, N. Y. *Secretary of the Council:* James Lewis Howe, Louisville, Ky. *Secretaries of the Sections:* (A) Mathematics and Astronomy—Wooster W. Beman, Ann Arbor, Mich.; (B) Physics—Benjamin W. Snow, Madison, Wis.; (C) Chemistry—S. M. Babcock, Madison, Wis.; (D) Mechanical Science and Engineering—John H. Kinealy, St. Louis, Mo.; (E) Geology and Geography—William Morris Davis, Cambridge, Mass.; (F) Zoölogy—William Libbey, Jr., Princeton, N. J.; (G) Botany—Charles R. Barnes, Madison, Wis.; (H) Anthropology—Alexan-

der F. Chamberlain, Worcester, Mass.; (I) Economic Science and Statistics—Manly Miles, Lansing, Mich. *Treasurer:* William Lilly, Mauch Chunk, Pa.

**A Correction.**—Owing to some defect, the cut on page 459 of the August number of the Monthly, intended to illustrate a peculiar form of lightning flash, fails to show the characteristic features of the phenomenon as brought out in the photograph. We present herewith another cut which is an excellent reproduction of the photograph, and with it an explanation of the peculiar appearances observed in the picture.

The illustration herewith is to be substituted for the illustration with the same legend on page 459 of The Popular Science Monthly for August. The flash was photographed by the writer at Blue Hill Observatory, and was one of the most intense flashes he has ever seen. To the eye it appeared as a straight core of dazzling light, with a jacket of luminous air in diameter six or seven times that of the core. The name "impulsive rush" is from Dr. Oliver Lodge's classification of lightning discharges. The so-called "dark flashes" can be distinctly seen branching out from the core. Briefly, these may be the result of previous exposure, and the flashes altogether distinct in time and place; or, a reversal of a flash brought about by the glare from subsequent illuminations; or, a reflection from the lens (although a plain view lens was used), or an absorption effect connected with chemical change in the gases of the atmosphere. It is needless to add that the negative was carefully kept from alteration or retouching of any kind.

Alexander McAdie.

Impulsive Rush Discharge. So called Dark Flashes.

**Reasons for Emigration.**—The conclusion of an inquiry made under the direction of our Commissioners of Immigration upon the causes that incite immigration to the United States is that, except in Russia, where emigration is abnormal, the primary causes are the superior conditions of living in the United States, the fewer hours of labor, the exemption from the exactions imposed by foreign governments upon their citizens, and the general belief that the United States presents better opportunities for rising to a higher level than are offered at home. Information on these points is usually furnished by friends or relatives who have preceded the intending emigrants and have established themselves here. It is estimated that nearly sixty per cent of the immigrants who land in our country come on prepaid tickets or money sent by friends

already here, and that they in turn influence a considerable percentage of immigration that comes on tickets purchased directly in the Old World. The prepaid business is largely affected and increased by even temporary improvement in our conditions here. So far as this class of immigrants is concerned, it argues against the belief that exists in the minds of many of our people that the quality of immigration, as to character, is inferior to that of former years, as it necessarily follows that the class who are prepaid, belonging to the same families as those who prepay, must be of the same general character. This information as to our conditions is also supplemented by the large number of persons who return to their native lands temporarily, and whose improved appearance, enhanced prosperity, and statements to their old friends disseminate the knowledge of the better conditions in this country. A reference to the table of steerage passengers returning to all parts of Europe during the year previous to the making of the report demonstrates the volume of this business. Low passage rates, sea and inland, affect the currents both coming and going. Generally, wherever the manufacturing industries are active emigration is sluggish; and it is small wherever the wages are fairly good as compared with the standard of wants and manner of living of the working people. In addition to the superior conditions prevailing here, the conditions in Europe greatly affect the outflow. Short crops, industrial depression, social persecutions, and rumors and anticipations of war swell the tide.

**Prof. N. T. Lupton.**—Nathaniel Thomas Lupton, Professor of Chemistry in the Alabama Agricultural and Mechanical College, a pioneer in America in teaching chemistry as a practical science, died in Auburn, Ala., June 11th. He was a native of Virginia; studied chemistry under Bunsen at Heidelberg, worked with him afterward, and made special investigations in his laboratory after his own fame had been established in America. He was engaged during a large portion of his life in original research, at home, in Mexico, and in Europe; was connected with several Southern institutions of learning, including ten years at Vanderbilt University, and built up the school of chemistry at Auburn, Ala. He was much interested in other sciences than chemistry, particularly with ethnology, and contributed largely from his Mexican, Western, and Southwestern researches to the Smithsonian collection of relics of the Indians and mound-builders. His own collection of minerals and prehistoric relics is extensive and interesting. He was twice President of the Chemical Section of the American Association, was President last year of the Association of Official Chemists of the United States, and was a member of several foreign scientific and other societies. He was the author of a book on scientific agriculture, and a frequent and valued contributor to the scientific publications of this country and Europe.

**Copper Works of the Aborigines.**—The present evidence regarding the use of copper by the aborigines of this country, as reviewed by R. L. Packard, in the American Antiquarian, appears to show that the metal had not passed its ornamental or precious stage on the seaboard or in the South at the time this continent was brought to the attention of Europe. It was not part of the native equipment, either for war, or hunting, or other useful purposes, and its position in the native economy was not like the noticeable part it played in the armament of the Mexicans and Central Americans of the same period. In the absence of evidence that the Indians of the United States had any knowledge of smelting, it must be inferred that all the copper they possessed was found in the metallic or native state. There is nothing to show that they were aware of the existence of copper ore as a source of metal. No remains of smelting places, or slag, or other indications of metallurgical operations have yet been found. The quantity of copper which the North American Indians possessed at the time of the discovery, although the metal was diffused over a very wide territory, was very small as compared with stone. This is shown by the relatively small proportion of copper implements in the principal collections, as at the Smithsonian Institution and the Peabody Museum. The larger numbers are found in Wisconsin, and this is accounted for by the fact that Wisconsin is directly south of the Keweenaw district in Michigan where the largest beds of native

copper occur. In these beds the copper is classed as stamp rock, in which the metal is contained in fine particles and is separated by crushing; "barrel work," or the pieces of copper that are large enough to be detached from the rock without stamping, which are shipped in barrels; and mass copper, or the very large pieces. All this copper shows as such in the rock, and the ancient miners had only to follow down a promising outcrop showing "barrel work" for a few feet, and hammer away the rock from the copper to secure the latter. When they came upon mass copper they were compelled to abandon it after hammering off projecting pieces, because they had no tools for cutting it up and removing it. Several instances of this sort have been found. The ancient mines were not mines in the strict sense of the word, because they were not underground workings, but merely shallow pits or trenches, and sometimes excavations in the face of the cliffs. At the time modern mining began they had become mere depressions in the ground. All these workings when examined contained countless stone hammers or mauls, a few wooden shovels, remains of wooden bowls for baking, birch-bark baskets, and some spear or lance heads, and other articles of copper. Opinions and evidence vary as to the age of the operations. Modern miners would regard the whole system as nothing more than prospecting work, and not mining proper, as there were no shafts or tunnels or underground workings.

**Feeding Value of Tree Leaves.**—Experiments on the feeding value of the leaves of trees, made by M. C. H. Girard, point to them as an available source of nutriment for cattle, particularly in times when hay and grain are scarce. The author has determined the content of nitrogenous matters in a considerable number of species. It ranges from eight per cent in the willow and alder to from three to four per cent in the plane, birch, and pine. Out of twenty-one kinds of leaves studied, nineteen possessed more nitrogenous matter than meadow hay, and more than half of them were superior to the hay of the best leguminous plants. Some are of extraordinary richness, the common acacia, for example. M. Girard was able, from his analyses and from direct experience in feeding sheep, to draw the conclusion that the leaves have a feeding value comparable to that of lucern. They are also superior in the proportion of fat matters and other carbohydrate principles to that of water. Leaves taken from various heights of the trees and from trees of various ages show but little variation in composition; and, putting aside the periods of youth and of extreme old age, the richness of the leaf in nutritive value remains almost stationary. Consequently, crops can be gathered during the three summer months; and in September the wood production of the trees would not be prejudiced.

**Gilbert White's Character.**—The Selborne Society, of London, celebrated the centenary of the death of Gilbert White, June 24th, by making a pilgrimage to Selborne, where the earl of that ilk spoke to the memory of White. He said that the impression which most people had formed of White from his book was that he was a man of excellent natural abilities, strongly cultivated, and of wide classical attainments and accomplishments. He was not only an observer of Nature, but one who prepared himself for observation by the best mental cultivation. No one could read his book without seeing his remarkable faculty of observation, and the constant aim at exactness and accuracy, together with a good deal of humor. Nor could any one help being struck with the modesty and simplicity of his character. His simplicity, which contributed a very great charm to the book, every now and then produced even a sense of amusement. The speaker was visited, in 1872, by Mr. W. M. Evarts, who, like most other cultivated Americans, was acquainted with White's book, and had a great regard for his memory. One day, when driving, the Sussex downs were pointed out to Mr. Evarts, who burst into laughter, remembering a passage in which White referred to the downs as "a vast range of mountains." His shrewdness of discernment was a most valuable gift, and he loved all God's creatures, but perhaps especially birds. By this he reminded one of two great men. The one, mythical, was Melacampus, who rescued and brought up some young serpents. One day, when he slept, the serpents nestled round his head, and when he woke he found he could under-

stand the language of birds. The other was Francis of Assisi, who was in some measure the forerunner of Gilbert White. There was a legend that he so loved the birds that they flocked around him while he preached sermons to them. The legend at least showed his love for those creatures and his power of making them love him. These characteristics of Gilbert White could be gathered from his book; but the picture was filled up by the mass of family correspondence which had just come to light. The combination of simplicity and refinement, the absence of ostentation and self-consciousness which constituted the great charm of White's book were equally conspicuous in his family correspondence and in his every-day habits. The Earl of Stamford, who has been collecting reminiscences and unexplored documents connected with his great relative, White, said that years ago an old woman was asked what she remembered of him. She said that he used to walk about the lanes tap-tapping with his cane, and stopping every now and then to brush the dust off his shoes.

**Unexplored Mountain Regions.**—While many of the mountain districts of the world, hitherto unexplored, have been reached in recent years by scientific mountaineers, yet, excepting Switzerland and the Pyrenees, which have been entirely explored by the different Alpine Clubs, there is no chain of mountains, as Mr. Edwin Swift Balch shows in his essay on Mountain Exploration, which is as yet thoroughly known or perfectly mapped out. New Zealand, though settled and inhabited by Englishmen for many years, had to wait till a few years ago for Mr. Green first to explore its Alps. The Himalayas, although the Indian Government has tried to map and explore them, are still in many cases keeping their secrets until men shall come along who know the science of climbing. Mr. Graham's trip in the Sikkim ranges in 1886 showed conclusively how little was known about the Himalayas, as he has now left us in doubt as to whether the two peaks which he saw from the top of Kabru were not higher than Gaurisankar. In America there is a large field left for mountain exploration. Of the Selkirks we know but little; St. Elias has not been reached; the Alaskan ranges and Mount Fairweather and Mount Cook are believed to be entirely untouched. The Mount Wrangel range is hardly known, even by name, and though it is said to have been measured and to be over twenty thousand feet high, we know practically nothing about it or its surroundings. On the map of the northern Rockies, north of the Selkirks, we find a bunch of peaks, called Mount Brown and Mount Murchison, and marked as being over sixteen thousand feet high. Of these mountains we again are in almost complete ignorance, though from Mr. Green's explorations we may doubt the accuracy of their supposed altitude. In South America the Andes of Peru and Chili are mostly still unascended, and even Ecuador has had only one serious exploration, by Mr. Whymper. Here is unexplored mountain country enough to occupy our clubs several years.

**Vegetation of American Deserts.**—The true sagebrush of the Western desert (*Artemisia tridentata*), according to Prof. C. Hart Merriam, begins with a solid front along the southern border of the upper Sonoran zone and spreads northward over the Great Basin like a monstrous sheet, covering almost without a break hundreds of thousands of square miles. It is not only the most striking and widely diffused plant of the upper Sonora and transition zones, but as a social plant has few equals, often occupying immense areas to the exclusion of all but the humblest and least conspicuous forms. Wherever one travels in this vast region, the aromatic odor of the sagebrush is always present, and sometimes, particularly after rains, is so powerful as to cause pain in the nostrils. In addition to the sage, many of the desert ranges support a growth of shrubs and small trees rarely if ever found in the intervening deserts and plains, whatever the altitude. The so-called cedar (*Juniperus californica utahensis*) and the piñon or nut pine (*Pinus monophylla*) clothe the summits and higher slopes of many of the ranges, forming stunted open forests of much beauty. Mixed with these are scattered clumps of bushes representing a number of genera, most of which bear green foliage and handsome flowers. Some of the desert ranges, as the Funeral Mountains, are too excessively hot and arid to support even these forms of vegetation;

others, as the Charleston Mountains, push their lofty summits into so cold an atmosphere that they obtain a covering of the boreal pines and firs. These higher mountains, when rising from the lower Sonoran deserts, present in succession all the extratropical zones of North America, which, from their close juxtaposition, may be here studied to unusual advantage. In ascending or descending such slopes the change from one zone to another is quickly recognized, and the altitude of first appearance of the various new species encountered may be recorded with considerable confidence. Not so, however with the species lost, for, except in the case of trees and such strikingly conspicuous forms as the yuccas, some of the cactuses, the creosote bush (*Larrea*), and a few others, it is exceedingly difficult to detect the disappearance of species when passing out of their ranges.

**The Rattlesnake's Rattle.**—The idea that the rattles of a rattlesnake correspond with its years is, according to Dr. Arthur Stradling, incorrect. "When the little *Crotalus* is born," this author says, "its tail is furnished with a single tip of horn, incapable of producing any sound by the violent vibration which its owner nevertheless communicates to it when excited. In some near relations of the rattlesnake, such as the *curucucu* of Brazil, this horny claw or nail persists throughout life without addition thereto. But in the rattlesnakes proper—and there are many species of them—two, and sometimes three, joints appear during the first few months of the creature's life; then and later there is probably no definite relation between their number or frequency of development and its age, though they may be proportionate in some measure to its rate of growth. Broods of young serpents belonging to this genus which I have reared have exhibited great diversity in this matter; so much so, that it has been impossible to base any calculation on observations of the phenomena presented by them. The overlapping 'thimbles' or cones of which the rattle is composed are thin, dry, and exceedingly brittle, and in consequence the instrument is easily broken off when it has reached the length of from one to two inches, though longer specimens are occasionally seen; twenty joints make an exceptionally big rattle. This shedding of the rattle is in all cases accidental, and is due to external causes, not a constitutional and periodical function like the casting of the skin. When it breaks off at the root or in the middle, there is generally no trace left of a fracture having taken place, as the thimbles are all alike, and any one forms a symmetrical termination to the organ. Whatever purpose the rattle may serve in the snake's economy—and its use is still involved in some obscurity—it undoubtedly does *not* represent the owner's age, nor the sum total of his manslaughter."

**Energy in Organic Evolution.**—In two papers, Mr. John A. Ryder has endeavored to demonstrate the potency of energy as a factor in organic evolution, and to show that the form of the hen's egg is determined by mechanical means while the egg membranes and shell are in process of formation within the oviduct. The development of the figure of eggs is regarded by him as a purely dynamical problem, or one in which energy is applied in a definite manner to a mass in statical equilibrium within the oviduct. The moment motion is set up to propel the egg through the duct the forces operative in determining the figure of the as yet unformed shell depend upon the physiological activity and condition of tone of the muscular walls of the oviduct.

**Cremation of Cholera-dead.**—From a paper read by Dr. Robert Newman before the Northwestern Medical and Surgical Society of New York in favor of the cremation of persons dying of cholera, it appears that there are now fifteen crematories in this country, and that two thousand and seventeen incinerations took place between 1887 and 1892, of which eight hundred and sixty-eight were at New York. The Earl Memorial Crematory, at Troy, is the most costly. Thirty-two active cremation societies are scattered over the country. Nearly all those who participated in the discussion of the paper agreed with the author as to the importance of cremation in cholera. In respect to the objection—the only really important and valid one that has been made—that cremation facilitates the concealment of crimi-

nal poisoning, the observation of an eminent but unnamed chemist was quoted, that alkaloidal poisons are destroyed by burial as well as by cremation, so that the only poison that would not be discovered after cremation and which might be detected after ordinary burial is arsenic.

**Endurance in Animals.**—The tradition, says an English writer, which assigns to certain animals a daring and endurance difficult to match in man, is so old, and on the whole so consistent, that it would be impossible to disregard it, even were the facts on which it is based less clearly within the limits of ordinary observation and comprehension than they are. It may even be doubted whether our measurement of animal courage has yet been sufficiently extended, for there appear instances in which the acts of daring are prompted by a sense of obedience, of discipline, and even of duty—something similar in kind to that which marks and distinguishes the highest forms of courage in man.

## NOTES.

An English edition of the Reminiscences of Werner von Siemens, to which we are indebted for the material of the sketch of him published in this number, is now in press and shortly to be published by D. Appleton & Co. It abounds in stirring incidents and bright anecdotes.

A World's Congress of Evolutionists has been called to meet in the Art Building, Chicago, September 27th, 28th, and 29th. Morning, afternoon, and evening sessions will be held each day. A carefully arranged programme of subjects has been provided for the discussions. The first subject, set down for the morning session of September 27th, is Constructive Evolution. Progress of the Doctrine in Forty Years. Its Present Scientific and Popular Status. Its Upbuilding and Beneficent Character. Other subjects, under each of which are several subheadings, furnishing a wide and varied scope for expression by different speakers from their respective points of view, are Biology as related to Evolution; The Heroes of Evolution (Darwin, Spencer, Wallace, Haeckel, Gray, Youmans, etc.); Psychology as related to Evolution; Sociology, with Evolution's Promise for the Settlement of Social Problems and the True Conservatism of Evolution; Economics as related to Evolution; Philosophy as affected by Evolution; Ethics, the Moral of Evolution; and the final series, Religion: how it is affected by the Doctrine of Evolution, Spiritual Implications in all Progress, Materialistic Speculations Untenable, The Immanent and Transcendent Power that makes for Beauty, Order, and Righteousness. The arrangements for the congress are under the guidance of Dr. Lewis G. Janes, James A. Skilton, and other persons of representative character. All friends of evolution are invited to attend.

A writer in the London Spectator suggests that, in studying the intelligence of animals instead of ourselves, we should compare them with men who are more or less in the same state of education with them. He lives in Bolivia, in a country close to three tribes of Indians who are more or less savages, although engaged in agriculture of a desultory kind; and he has had it forced upon him on various occasions that the nobler animals—such as the horse and the dog—are quite as capable of "reasoning" or "thinking" out the ordinary problems of maintaining their existence as those savages. "Of the wild animals, many put whatever brain power they possess to 'cunning.' Again, what is 'cunning'? Their cunning is very similar to that of the Indians of this country, who would rank high among savage races."

According to an observation by C. Margat, of the University of Geneva, when aluminum, previously well cleaned, is lightly rubbed with an amalgam, its surface becomes covered with an arborescence of alumina, which can literally be seen to grow, and in the course of half an hour the forest may reach the height of a centimetre. The growth ceases on the application of heat, to be resumed on a new rubbing with the amalgam. If the forest growth is brushed away, the surface of the metal where the oxidation was most rapid will be found to have been eaten, as if with an acid. The mercury acts in some way to make the aluminum more amenable to oxidation. The experiment is more conveniently performed with an amalgam than with pure mercury, because the amalgam can be powdered and brought into more immediate contact with the aluminum.

In the investigation of the purity of the ice supplied to Paris, Lac Daumesnil at Vincennes, whence a considerable proportion of the natural ice comes, has been found to be polluted by the entrance of a sewer and by an artificial stream from the plateau of Gravelle. It is proposed to limit the use of this ice to applications in which it is not brought into direct contact with the articles to be cooled, and to enforce the use of artificial ice got exclusively from spring water or from river water sterilized by heat, when such contact takes place.

Lake Memphremagog, on the line between Vermont and Canada, has been sub-

jected to a hydrographic examination by Mr. A. T. Drummond. It is a deep-water lake, giving soundings of six hundred feet, and is found by Mr. Drummond to be also a cold-water lake, giving bottom temperatures in August of 41·75 Fahr., with the high surface temperature maintained for relatively only a few feet; beneath this depth the mercury falls rapidly toward the lowest reading.

A writer in the Lancet calls attention to our still persisting lack of practical knowledge on the hygiene of schools, although a complete revolution has taken place during the past fifty years in our ideas relating to the management of children and the methods to be adopted in educating the young. This position of affairs seems to have arisen, not from any want of knowledge in sanitary affairs, but rather from lack of system in following up the subject. We habitually insist that certain conditions shall be fulfilled before a dwelling house shall be considered habitable or a hospital fit for the reception of patients, and in other matters, but do not as firmly stipulate that certain rules shall be followed in the building of schoolhouses.

A number of the plates—so many of them being missing as to preclude the formation of complete sets—of Audubon's Birds of America, are offered for sale by Estes and Lauriat, Boston, at largely reduced prices. Of many of the plates but few copies are in store, and, the original stones having been destroyed, it is certain that no more copies will be published.

Volume V, No. 2, of Insect Life is chiefly filled with proceedings of the sixth meeting of the Association of Economic Entomologists, which was held in connection with the meeting of the American Association at Rochester in August, 1892.

Metallurgy is tending to become one of the most efficient producers of manures in the world. Twenty years ago, says the *Annales industrielles*, twenty thousands tons of phosphoric acid were as poison to the two million tons of cast iron which England produced, while English ships were ransacking the most distant regions of the globe for phosphoric acid for agriculture. The basic process has been the end of this anomaly. Apparatus attached to the furnaces in Scotland for the recovery of the ammonia out of the furnace gases have furnished a new and important source of sulphate of ammonia for agriculture.

A curious method of anthropometrical measurement for the determination of identity is described by the French Captain Cupet as in use in southern Anam. A sliver of bamboo is placed between the middle and fore fingers of the left hand of the person it is desired to identify, and on it notches are cut to mark the base of the nail and the distance between the phalanges. The stick is kept, to be used as occasion requires when the identity of the person in question is to be established.

The emerald mines of Muzo, Colombia, are situated on the Minero River, about eighty miles northwest of Bogotá, and are farmed out to a French syndicate. They are situated in a very rough, wild country, with nearly impassable roads, and are worked by open cuts, with provision for washing away the *débris*. The rough stones are for the most part sent to Paris to be cut. About three hundred natives are employed at the works, and the yield is about one hundred thousand dollars a year.

The advance in the knowledge of the coal fields of India, promoted by the Geological Survey of the country, is great. The centers of production, which a few years ago were almost confined to Bengal, have been extended to Assam, the Punjaub, the central provinces, the Nizam's territory, and Burmah. The survey has also done much to determine the character of the oil resources of the country. The Government is anxious to associate natives educated in the country with the European officers in the work of original investigation and research; but the attempt has had to be abandoned for the present in consequence of the difficulty of finding young men suitably educated for such a career.

## OBITUARY NOTES.

The Rev. Charles Pritchard, D. D., Savilian Professor of Astronomy in the University of Oxford, whose death was recently announced, was in his earlier life a teacher in the English upper middle-class schools, in which he distinguished himself by his efforts to exhibit an improved method of education. After thirty years of this occupation, he retired to become an active clergyman, but in 1870 was offered and accepted the professorship at Oxford. Here he secured the establishment of the university observatory; applied photography, before the gelatin plate came into use, to the moon and other bright objects; devised and used a method of investigating the magnitude of the brighter stars through a process of extinction by means of a wedge of neutralized glass; visited Egypt to determine the amount of atmospheric absorption; studied the mutual proper motions of the stars of the Pleiades; and began the investigation of the parallax of stars of the second magnitude.

The death, on August 16th, is announced of M. Jean Martin Charcot, of the Salpêtrière, Paris, the eminent specialist in diseases of the nervous system. He was most distinguished for his researches in the field of insanity, hysteria, hypnotism, and of all those nervous phenomena which have been associated by many with magnetic influences.

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